

LEGO DACTA®

# Control LAB™



## Quick Start Guide: Creating A Fan Control Project



The *educational* division of the LEGO Group.



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# Quick Start Guide: Creating a Fan Control Project

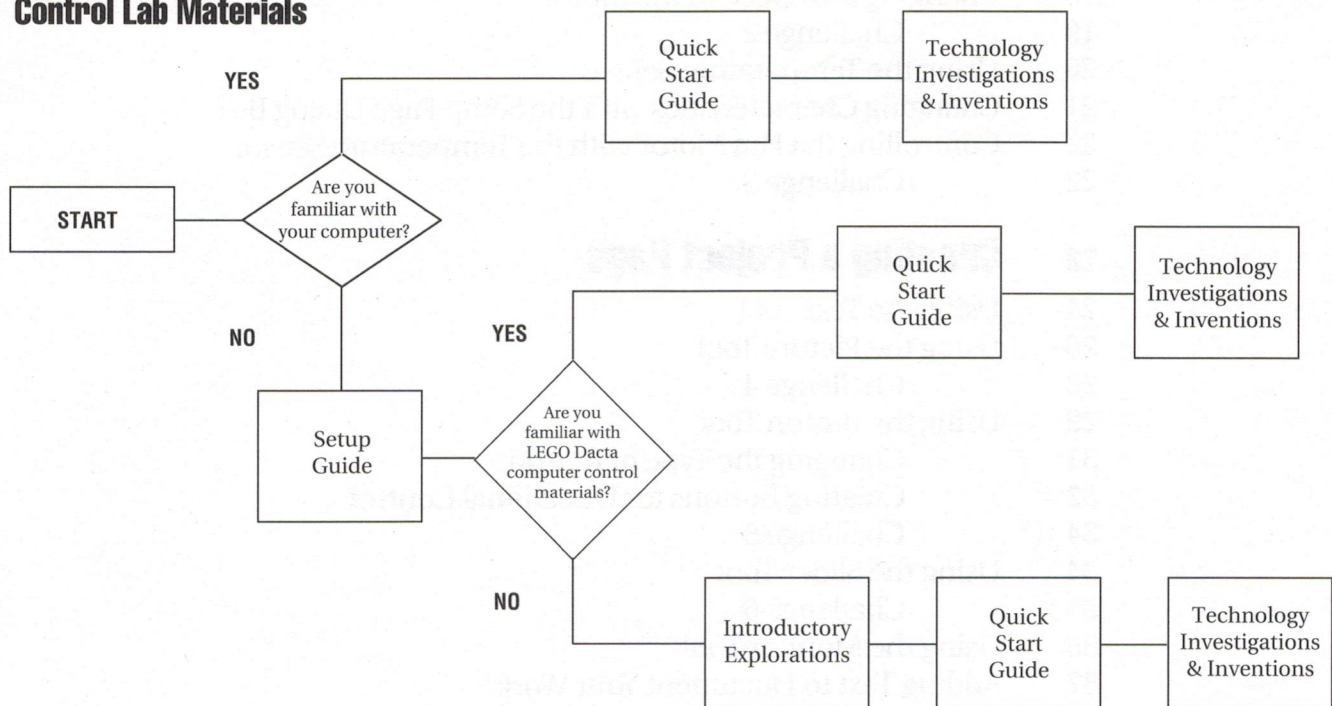
The *Quick Start Guide* is written for users who want to explore the LEGO DACTA® Control Lab materials immediately in an active, hands-on way.

*Quick Start* includes a series of fast-paced, sequential activities that introduce LEGO DACTA Control Lab building, programming and documentation features. Completing the *Quick Start* activities prepares users for the problem solving activities in the *Technology Investigations and Inventions* book.

*Quick Start* assumes that users are familiar with their computer system and control technology concepts. If you are unfamiliar with your computer or with control technology, please go to the *Setup Guide and Introductory Explorations* book.

If you have completed the *Setup Guide and Introductory Explorations* book, begin at page 6 of the *Quick Start Guide*.

## Routes Through the LEGO DACTA Control Lab Materials



### ► Registration - Do This First!

Please fill out the enclosed customer registration card now and mail it in. By returning the card, your software license will be acknowledged by LEGO Dacta and you will receive information about enhancements to the LEGO Dacta system.

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# Introduction

Welcome to the LEGO DACTA® Control Lab system from LEGO Dacta. With this material you can build LEGO Dacta models and control them with your computer.

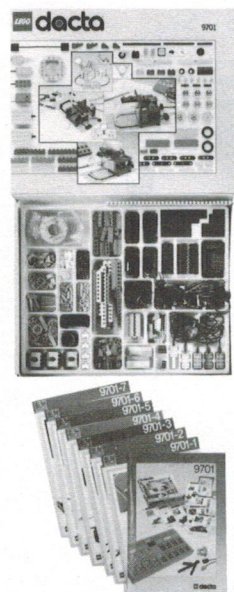
## Equipment List

You must have the following items to use the Control Lab system.

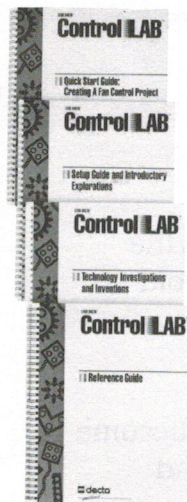
- LEGO DACTA Serial Interface and transformer #9751
- The LEGO DACTA Technology Set #9701
- Control Lab software #066 individual program or #068 site license (Macintosh®) or #067 individual program or #065 site license (MS-DOS)
- Curriculum materials #998
- A cable to connect the Serial Interface to your computer #9769 (Macintosh) or #9768 (MS-DOS; includes 9 and 25-pin connectors)
- A suitable Macintosh or MS-DOS computer (see requirements listed below)



Item #9751



Item #9701



Item #998

## Macintosh Minimum System Requirements

- 1 megabyte (MB) RAM
- System 6.0 or higher
- Finder 6.0 or higher
- 1 serial modem or printer port available
- Color or monochrome monitor
- Hard disk
- To load the color version, you must have a high density 3.5" disk drive



Item #066 or #068 for Macintosh



Item #9769 for Macintosh

## MS-DOS Minimum System Requirements

- 640K RAM (1 megabyte is recommended)
- DOS version 3.1 or higher
- Mouse
- Mouse driver 6.24 or higher (Microsoft® standard)
- 1 serial port (in addition to the mouse port)
- EGA color or monochrome monitor
- Hard disk
- A 3.5" disk drive or a high density 5.25" disk drive



Item #067 or #065 for MS-DOS

Item #9768 for MS-DOS



## Teacher note

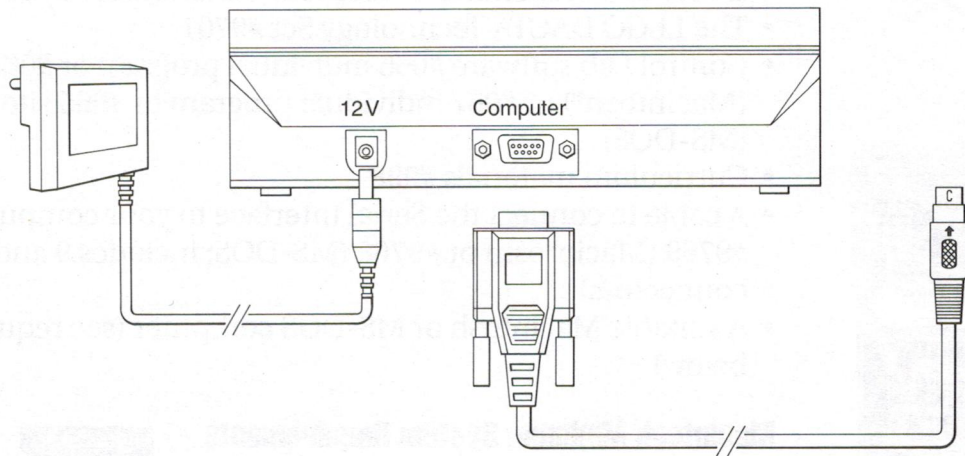
If you have questions about the items, contact LEGO Dacta at (800) 527-8339.



## Macintosh Information to Install LEGO DACTA® Control Lab

You can attach the cable to the printer port; however, if you do, remember to select Preferences from the Control Lab File menu and change the setting from Modem to Printer.

- ▶ Turn off the computer.
- ▶ Attach the cable for the LEGO DACTA® Control Lab Serial Interface to the modem port of your computer.
- ▶ Attach the transformer to the Serial Interface. Connect the other end to an electrical outlet.



If you have problems setting up the Control Lab system, review the complete instructions in the *Setup Guide* or see the Troubleshooting Help section at the back of the *Setup Guide and Introductory Explorations* book.

Control Lab will not run if:

- Appletalk is active and you are using the printer port for the Control Lab interface.
- The computer is set to use the serial port to which the Control Lab interface is attached for another purpose (e.g. telecommunication).

- ▶ Turn on the computer.
- ▶ Insert the Control Lab disk in the disk drive.
- ▶ Open the disk by double-clicking.
- ▶ Drag the Control Lab icon from the Control Lab disk onto the hard disk.
- ▶ Wait for the copy to be completed. Respond to any dialog boxes displayed by the Macintosh System.
- ▶ Store the Control Lab disk in a location safe from magnetic or physical damage.

This disk is your backup copy. In case the software you copied to the hard disk is damaged, you can copy from the backup disk and avoid paying for a replacement disk.

You have set up and installed the Control Lab software on your computer. Now you are ready to try the activities in this book to become familiar with the Control Lab software features, motors, lamps and sensors.

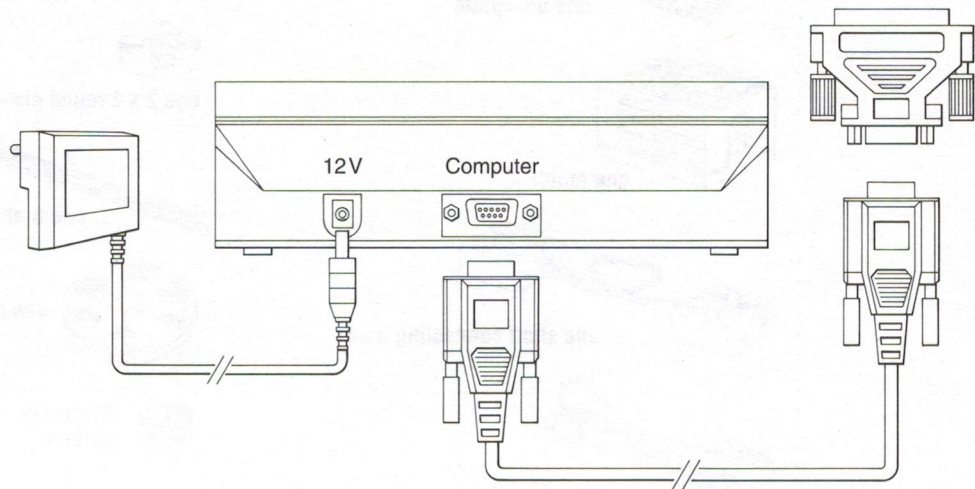


## MS-DOS Information to Install LEGO DACTA® Control Lab

Control Lab is automatically set to run the interface box from the serial port configured as COM1.

You can attach the cable to a COM2 serial port; however, if you do, remember to select Preferences from the Control Lab File menu and change the setting from COM1 to COM2.

- ▶ Turn off the computer.
- ▶ If the serial port requires a 25-pin connector, attach the extra 9 to 25-pin converter included with the cable.
- ▶ Attach the cable for the LEGO DACTA Control Lab Serial Interface to the serial port of your computer.
- ▶ Attach the transformer to the Serial Interface box. Connect the other end to an electrical outlet.



See the *Setup Guide* book section entitled "Install the Software" for more information if you need help.

If you have problems setting up the Control Lab system, review the complete instructions in the *Setup Guide* or see the Troubleshooting Help section at the back of the *Setup Guide and Introductory Explorations* book.

- ▶ Turn on the computer.
- ▶ Insert the Control Lab disk in the disk drive.
- ▶ Follow the usual method for copying software on your system. Copy the Control Lab files onto a hard disk.
- ▶ Store the Control Lab disk in a location safe from magnetic or physical damage.

This disk is your backup copy. In case the software you prepared is damaged, you can copy from the backup disk and avoid paying for a replacement disk.

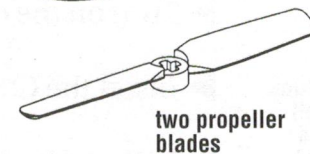
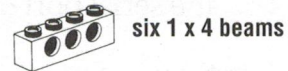
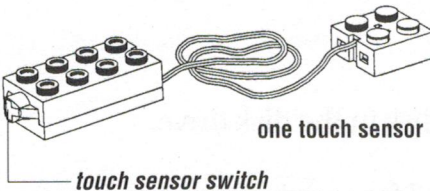
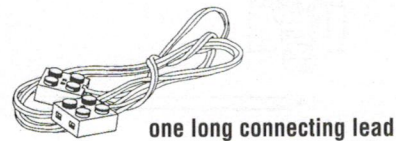
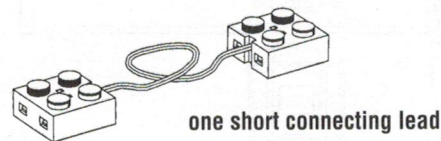
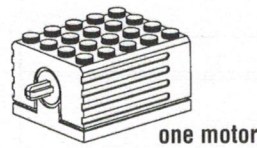
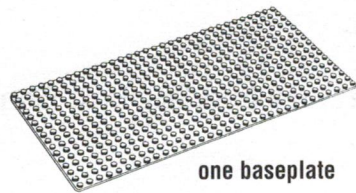
You have set up and installed your system. Now you are ready to try the activities in this book to become familiar with the Control Lab software features, motors, lamps and sensors.



# Building a Model: The Fan

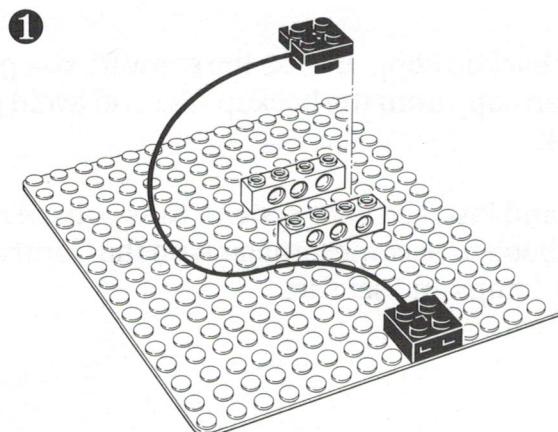
Before using the computer, you need a model with output and input devices to control. For all of the *Quick Start* explorations, you will use a motorized fan model.

► Build a fan using the following elements.



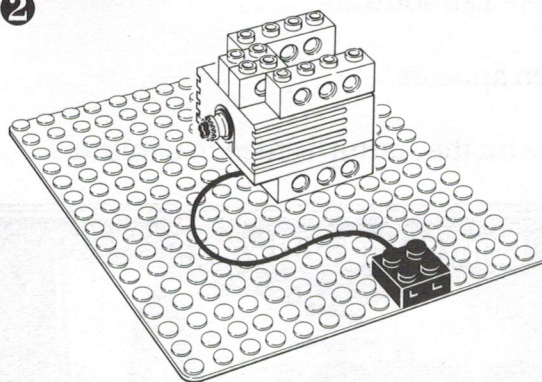
Attach the 2x2 round plate to the bottom of the connector plate.

► Connect the elements to make the fan model.

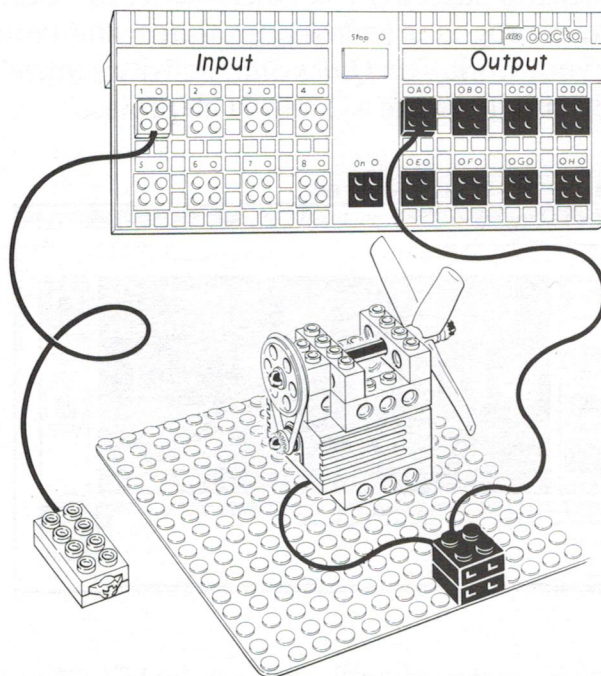
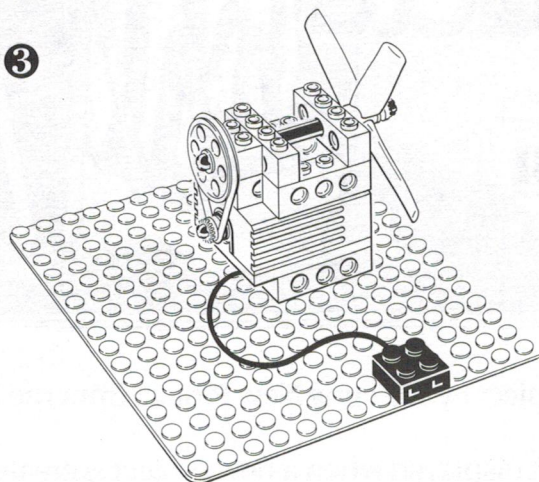




2



3



► Attach a long connecting lead to the short connecting lead. Then attach the other end of the long connecting lead to output port A on the LEGO DACTA® Serial Interface.

► Attach the touch sensor to input port 1 on the interface box.

The next exploration explains how to control the fan using the LEGO DACTA Control Lab software.

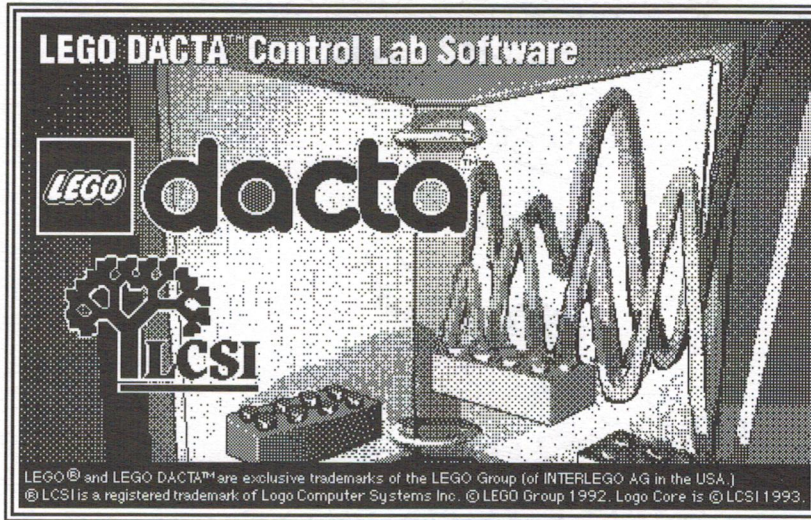


## Starting the LEGO DACTA® Control Lab Software

- Load the Control Lab software.

The startup screen appears.

- Click anywhere on the startup screen to continue.



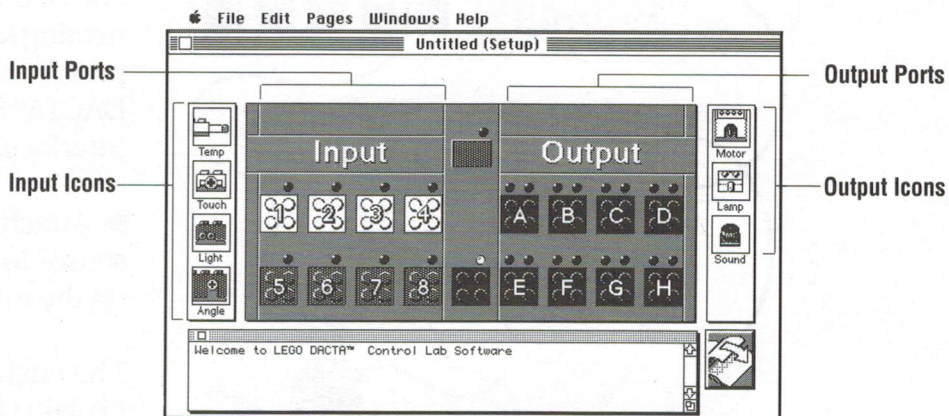
The illustrations used throughout the *Quick Start Guide* are from the Macintosh version of Control Lab. Any differences between the Macintosh or MS-DOS versions are noted in the text.

File	Edit	Pages	Win
New Project		⌘N	
Open Project...		⌘O	
Close Project		⌘W	
Save Project		⌘S	
Save As...			
Preferences			
Printer Setup...			
Print Project		⌘P	
Print Page			
Quit		⌘Q	

- Start a new project by selecting New Project from the File menu.

The Setup page is displayed when a new project is created.

Along with the Setup page, a project includes a Procedures page for writing computer programs (called procedures) and Project pages for documenting your work. The *Quick Start* activities introduce all of the features you can use to create a Control Lab project.



The Setup page is used to identify and test the LEGO® output and input devices used in a project.

The fan model uses a motor output and a touch sensor input.

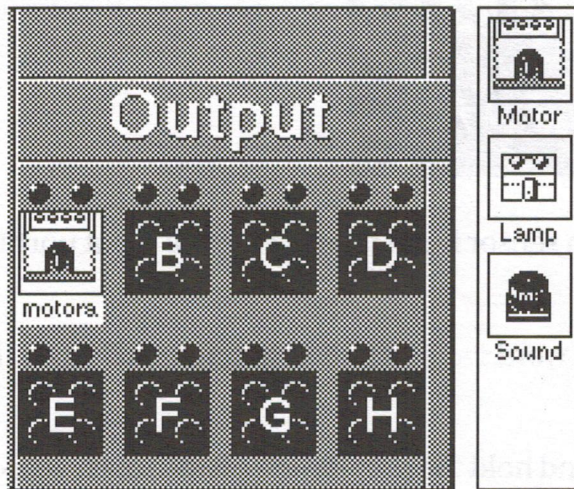


## Testing the Motor on the Setup Page

► Drag a motor icon over to output port A on the Setup page.

The name `motora` appears automatically. It means that LEGO DACTA® Control Lab software “knows” a motor is attached to output port A on the LEGO DACTA Serial Interface.

To remove an icon from a port on the Setup page, drag it to an area of the screen where there are no ports.



The motor icon on the Setup page is now connected on the screen the same way the actual LEGO fan motor is connected to the Serial Interface.

► Click and hold on each of the small circles above the motor icon. What happens?

The fan motor turns one direction when the circle is activated. The fan motor turns the opposite direction when the other circle is activated.

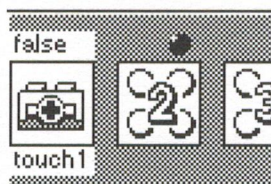
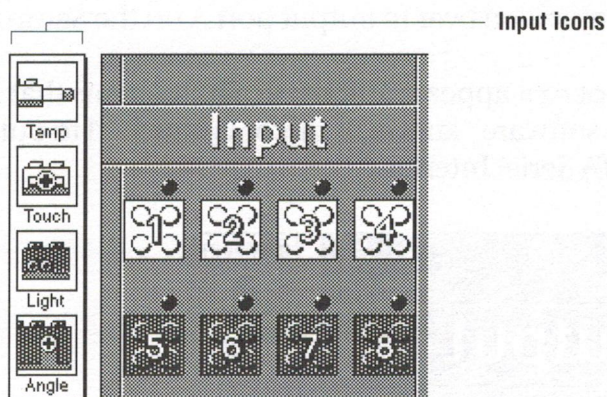
Notice that when you click on the circles over the port on the Setup page, the corresponding indicator lights on port A of the Serial Interface also light up.

If the motor did not turn on, check the following:

- The Serial Interface is connected to a transformer.
- The transformer is connected to an electrical outlet.
- The serial cable is connected to the interface and to the serial port of your computer.
- Macintosh users: The Preference option in the File menu is set to correspond to the appropriate serial port (modem or printer).
- MS-DOS users: The Preference option in the File menu is set to correspond to the appropriate “com” (communications) port.



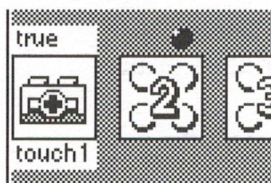
## Testing the Touch Sensor on the Setup Page



► Drag a touch sensor input icon over to the input port 1 on the Setup page.

Notice that the word `false` appears automatically over the touch sensor icon.

► Now press and hold the grey switch on the touch sensor.



The word `true` appears over the touch sensor icon on the Setup page.

You have tested the motor output and the touch sensor input on the Setup page. This is operator control: you turned the fan on and off yourself. Next, you will use a computer to automatically turn on the fan using LEGO DACTA® Control Lab Logo commands in the Command Center.

If `true` did not appear, make sure the interface box is attached to the serial port of the computer, the power is on to the interface box and the touch sensor is attached to port 1. Then try pressing the touch sensor again.

Control Lab includes two types of sensors: powered and unpowered. The unpowered touch and temperature sensors are color-coded yellow. The powered angle and light sensors are color-coded blue. Yellow unpowered sensors must be attached to yellow input ports 1-4. Blue powered sensors must be attached to blue input ports 5-8.

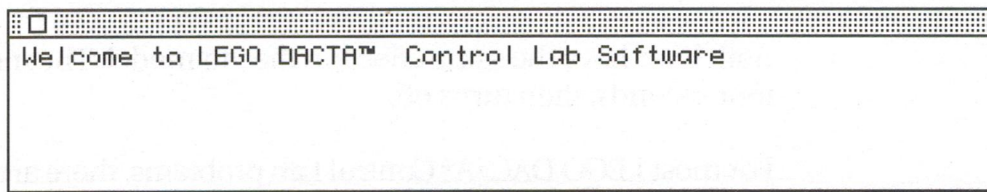


## Using the Command Center to Control the Fan Motor

The Command Center appears whenever LEGO DACTA® Control Lab software is loaded. You can use the Command Center at any time by clicking in it when it is visible.

The Command Center window can be moved around on the screen. If it is not visible, select Command Center from the Control Lab Windows menu.

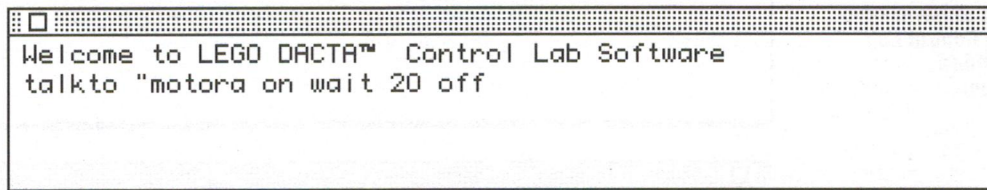
### The Command Center



Use the Command Center to enter Control Lab Logo commands directly.

► Make sure the fan motor is connected to port A. Then enter the following in the Command Center.

Capital or lower case letters can be typed.



### Macintosh users:

Press the Return key after each line.

After you press the Return or Enter key, the fan motor turns on for two seconds, then turns off.

### MS-DOS users:

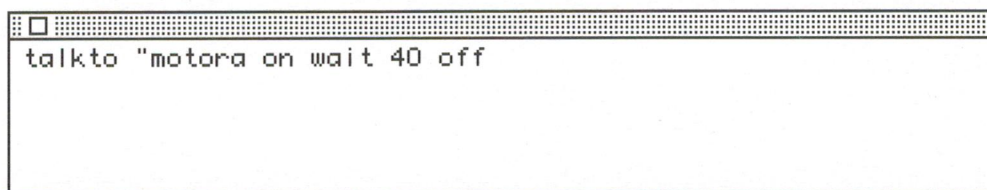
Press the Enter key after each line.

A black dot appears at the end of a line of instructions that is running in the Command Center. When the line of instructions has finished, the black dot disappears and the cursor returns.

► To clear the Command Center, type `cc` on a separate line.

► Type each of the following lines in the Command Center. Press Return or Enter after each one and observe the fan model to see what happens.

See the *Reference Guide* or Help menu in the software for more information about the Control Lab primitives (software commands and reporters).





### Experienced Logo users:

Setright and setleft can be used to set the direction of the motor and sound elements. See the *Reference Guide* or Help text in the Control Lab menu for more information.

```
☐ talkto "motora onfor 40
```

► What did you observe?

Both lines have the same effect on the fan model. The motor turns on for four seconds, then turns off.

For most LEGO DACTA® Control Lab problems, there are many ways to program a solution.

► Type each of these series of commands in the Command Center. Compare what happens.

```
☐ repeat 4 [talkto "motora on wait 10 off rd]
```

```
☐ repeat 4 [talkto "motora onfor 10 rd]  
|
```

Both of these lines have the same effect on the fan model. They repeat four times turning on the fan motor for one second and reversing its direction.




---

## Summary of LEGO DACTA® Control Lab Logo Commands

talkto	Address an output device such as a motor. Example: talkto "motora
tto	A short form of talkto. Example: tto "motora
on	Turn on the output device being addressed (talked to.)
rd	Reverse the direction of the motor (or other output devices) being addressed.
off	Turn off the output device(s) being addressed.
wait	Cause a delay for an amount of time. The amount of time must be in tenths of seconds. Example: wait 20 means pause for 2 seconds.
onfor	Turn on an output device for a specific amount of time in tenths of seconds. Example: onfor 50 means turn on for 5 seconds, then turn off.
repeat	Repeat a list of instructions for a specific number of times. Example: repeat 5 [onfor 10 rd]
cc	Clear the Command Center.

### Challenge 1

 **Teacher note:**  
Suggested solutions to all Challenges in the *Quick Start Guide* can be found in Appendix C on page 49.

► Using the commands you have learned, put together your own sequence to turn on the fan for one minute, reverse its direction and turn it on for another minute.



## Using the Touch Sensor to Control the Motor

With a touch sensor and some additional LEGO DACTA® Control Lab Logo commands, you can create a switch to control the fan.

► Make sure the fan motor is connected to port A and the touch sensor is connected to port 1.

► Type the following Control Lab instructions in the Command Center and press Return or Enter.

```
☐ waituntil [touch1] talkto "motora on  
|
```

► Press the touch sensor switch.

The fan motor turns on.

► Now type this line in the Command Center and press Return or Enter.

```
☐ waituntil [touch1] talkto "motora off  
|
```

► Press the touch sensor switch again.

The fan motor turns off.

Using the `waituntil` command, you can program Control Lab to pause until you press the touch sensor. After you press the touch sensor, Control Lab runs the instruction to turn on the motor.

► Contrast the effect of using `waituntil` with this `if` statement. Type the following in the Command Center and press Return or Enter. What happens?

```
☐ if touch1 [talkto "motora on]  
|
```

If you do not wish to retype the entire line, just click in the Command Center, highlight `on` and type `off`. Then press Return or Enter.



To execute a line again without retyping, click on the line or use the arrow keys to move to it. Then press Return or Enter. The cursor can be anywhere on the line; it does not need to be at the end.

Nothing appears to happen. However, LEGO DACTA® Control Lab did check if the touch sensor was pressed. Since it was not, Control Lab did not turn on the fan and gave the cursor back to you.

► Execute the `if` statement again. But this time press and hold the touch sensor switch before pressing Return or Enter. What happens?

The fan motor turns on because the touch sensor switch is pressed.

The computer can check an `if` statement so quickly that it is often helpful to run the same instruction continuously.

► Type this line in the Command Center and press Return or Enter. Then press the touch sensor.

```
forever [if touch1 [talkto "motora on]]
```

The `forever` command runs the `if` statement continuously, so whenever you press the touch sensor the motor turns on.

► Type `off` to turn off the motor. Then press the touch sensor again.

The motor turns on again.

► Type this line in the Command Center and press Return or Enter. What happens?

```
forever [if not touch1 [talkto "motora off]]
```

The motor turns off.

The phrase `not touch1` means, "when the touch sensor is not being pressed." The whole line then means, "Check continuously: if the touch sensor is not being pressed, turn off the motor." Since you were not pressing the touch sensor, the fan motor turned off.

► Press in the touch sensor switch and release.



The motor turns on while the touch sensor is being pressed and turns off when the touch sensor is released.

► Type `stopall` to stop the `forever` statements.

You can also select the `stopall` command by selecting it from the Edit menu. Or use the short-cut keys `⌘-period` (Macintosh) or `Alt-K` (MS-DOS).



### Teacher note:

See the Supplemental Material section of the *Technology Investigations and Inventions* book for Quick Reference pages that can be copied and distributed to students.

### Summary of Important LEGO DACTA® Control Lab Logo Commands

<code>touch1</code>	Reports the state of a touch sensor attached to input port 1. Must be used with a command such as <code>waituntil</code> or <code>forever</code> . Example: <code>waituntil [touch1]</code> means pause until the touch sensor is true (pressed).
<code>not</code>	Reports the inverse or opposite. Example: <code>waituntil [not touch1]</code> means pause until the touch sensor is not true (not pressed).
<code>waituntil</code>	Causes Control Lab to pause until a certain condition is met. Example: <code>waituntil [touch1]</code> means pause until the touch sensor in port 1 is pressed. The input to <code>waituntil</code> must be put into a list. Lists are surrounded by square brackets <code>[]</code> .
<code>if</code>	Causes Control Lab to check whether a condition is met. Example: <code>if touch1 [talkto *motora on]</code> means if the touch sensor in port 1 is pressed, turn on the motor in port A.
<code>forever</code>	Continues running a list of commands until the <code>stopall</code> command is executed. Often used with an <code>if</code> statement. Example: <code>forever [if touch1 [talkto *motora on]]</code> . The input to <code>forever</code> must be put into a list. Lists are surrounded by square brackets <code>[]</code> .
<code>stopall</code>	Stops all Control Lab processes that are running, including those that contain <code>forever</code> .

You now are able to control the LEGO motor and touch sensor using several important Control Lab instructions in the Command Center.

Next, you will learn to write procedures so that you can store a sequence of instructions on a disk and extend the computer control capabilities.



## Writing Procedures

Pages	Windows
New Page	
Setup	⌘1
Procedures	⌘2
Page1	⌘3

On the Procedures page you can type one or more procedures.

Unlike in the Command Center, the computer does not try to run the commands after you press the Return or Enter key on the Procedures page.

All procedures must start with the word `to` followed by a name, and finish with the word `end` on a line by itself. Procedure names can be many characters long but cannot include spaces.

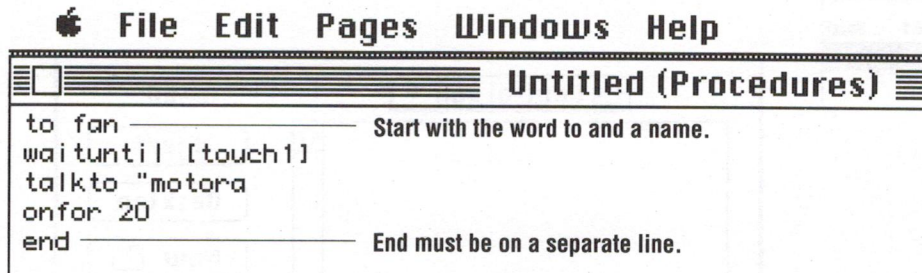
To activate the Command Center, click in it. If it is not present, select it from the Control Lab Windows menu.

The black dot after the word `fan` indicates that the procedure is running.

A procedure is an organized set of Logo instructions. Unlike the Command Center instructions, procedures are saved as part of a LEGO DACTA® Control Lab project on a disk.

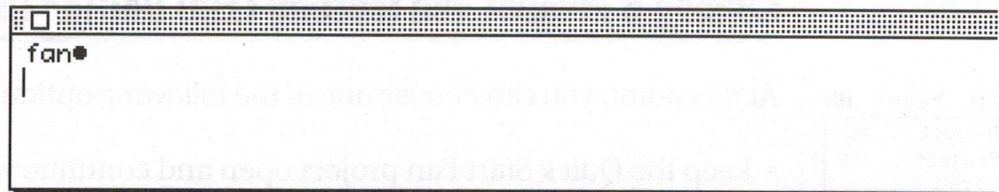
► Select Procedures from the Pages menu.

► Type the `fan` procedure on the Procedures page.



The `fan` procedure waits until the touch sensor is pressed before turning on the fan motor for 2 seconds.

► Activate the Command Center. Then type `fan` in the Command Center and press Return or Enter.



► Press the touch sensor to turn on the fan motor.

You have learned to put sequences of Control Lab instructions into procedures on the Procedures page. Procedures are powerful for two reasons:

- Many instructions can be combined into one procedure, so typing one word in the Command Center can start many actions.
- Procedures can be saved on a disk and retrieved later. Instructions typed into the Command Center are not saved.

Procedures can be used in many ways to provide automatic control of Control Lab devices.



## Saving Your Work

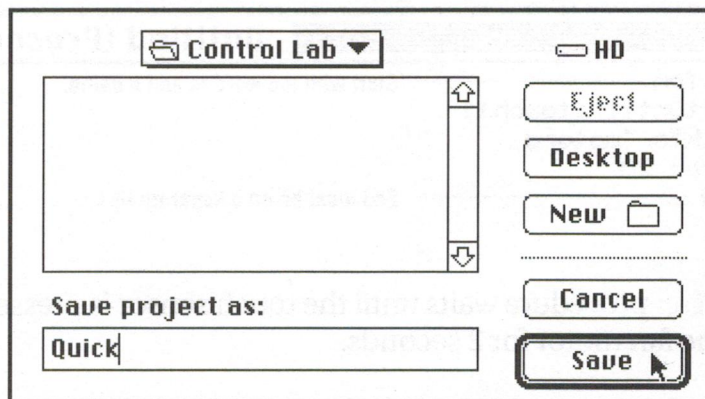
It is always a good idea to save your computer work every few minutes.

The Procedures page is stored along with the Setup page and other Project pages (described in the next section) as a project file.

- ▶ To save, select Save Project from the File menu.
- ▶ Type the name Quick. Then press Return or Enter.

File	Edit	Pages	W
New Project	⌘N		
Open Project...	⌘O		
Close Project	⌘W		
Save Project	⌘S		
Save As...			

MS-DOS users are limited to 8 character names.



## Closing a Project and Quitting LEGO DACTA® Control Lab

At this point, you can choose one of the following options:

- keep the Quick Start Fan project open and continue working.
- shut down the Control Lab software by choosing Quit from the File menu.

To stop using a project but keep Control Lab software running, choose Close Project.

Use Open Project when you are ready to resume working on a previously saved project.

File	Edit	Pages	W
New Project	⌘N		
Open Project...	⌘O		
Close Project	⌘W		
Save Project	⌘S		
Save As...			
Preferences			
Printer Setup...			
Print Project	⌘P		
Print Page			
Quit	⌘Q		



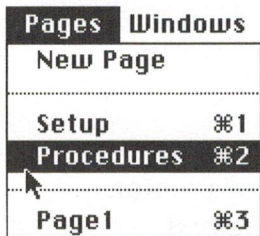
## Changing the Speed of the Motor

In the previous *Quick Start* explorations with the fan, you controlled two states of the motor: on and off.

Using a new command, `setpower`, you can also control the speed of the motor.

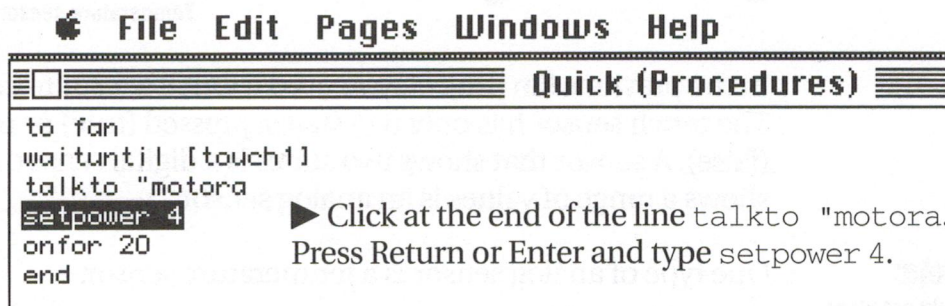
► If you had quit the LEGO DACTA® Control Lab software, load it. Then select Open Project from the File menu. Choose the project named Quick.

► Select Procedures from the Pages menu.



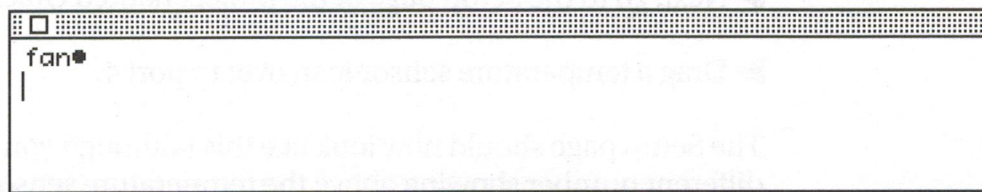
Make sure the touch sensor is connected to port 1 and the fan motor is connected to port A on the interface box. Also make sure the touch sensor icon is placed on port 1 and the motor icon is placed on port A of the Setup page.

The `setpower` command requires a number as input. In the `fan` procedure, the input to `setpower` is the number 4. The input number is the level of power for the motor (or other output device) the computer is "talking to." `Setpower` needs an input number between 0 and 8. The highest power level is 8, the lowest is 0.



► Click at the end of the line `talkto "motora`. Press Return or Enter and type `setpower 4`.

► Type `fan` in the Command Center to run the modified procedure. Then press Return or Enter.



► Press the touch sensor to turn on the fan motor.

The fan turns on at a lower speed.

### Challenge 2

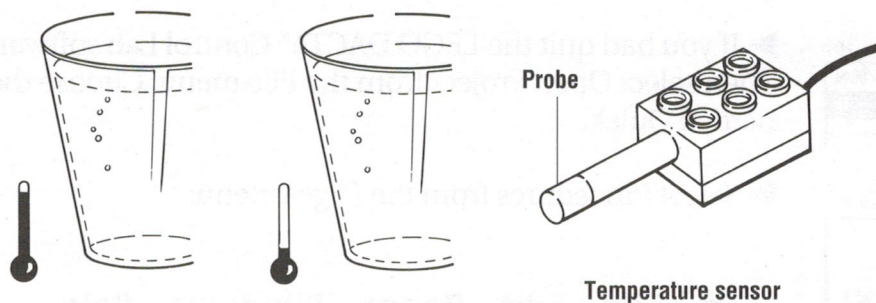
► Write a procedure that runs the fan for a few seconds at a high power level and then runs the fan for a few seconds at a low power level.



## Using the Temperature Sensor

For this activity, you need these additional materials:

- a cup of warm tap water
- a cup of cold tap water
- a temperature sensor



In the previous fan project, you used a touch sensor to control a motor. The touch sensor has only two states: pressed (true) or not pressed (false). A sensor that shows two states is a digital sensor. A sensor that shows a range of values is an analog sensor.

### Teacher note:

Students should not place the sensor in their mouths, ears, etc. for sanitary reasons.

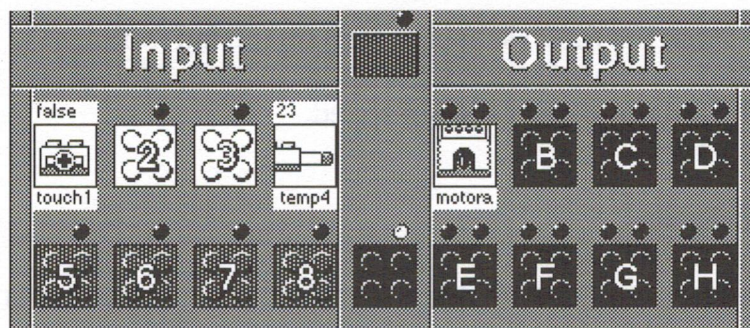
One type of analog sensor is a temperature sensor.

► Connect a temperature sensor to input port 4 of the LEGO DACTA® Serial Interface. Make sure the fan motor is connected to output port A, and the touch sensor is connected to input port 1.

► Next, go to the Setup page of the project named Quick.

► Drag a temperature sensor icon over to port 4.

The Setup page should now look like this (although you may have a different number showing above the temperature sensor icon).



► Hold the probe of the temperature sensor in the cup of warm tap water for a few seconds and observe the number above the temperature sensor icon.





The number increases in response to the water temperature.

► Hold the probe of the temperature sensor in the cup of cold tap water for a few seconds and observe the results.



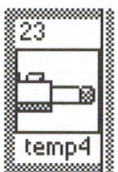
The number above the temperature sensor icon decreases in response to the water temperature.

### Important:

Hold only the probe of the sensor in the water. Do not submerge the whole element.

## Changing Characteristics with the Setup Page Dialog Box

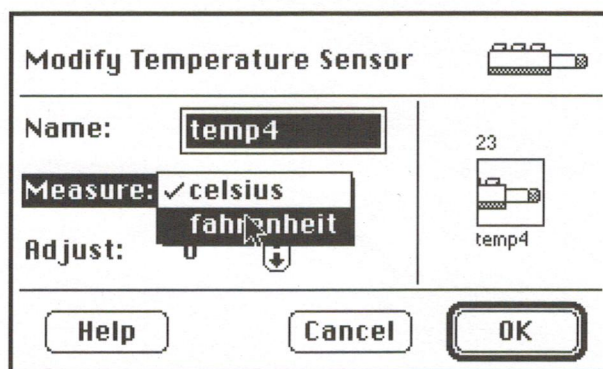
The temperature sensor values are automatically reported in degrees Celsius; however, you can change the reading to degrees Fahrenheit.



► First, double-click on the temp4 icon to see the dialog box.

► Click and hold down on the word Celsius by the Measure option. Select Fahrenheit from the popup menu.

► Click OK to close the dialog box.



All inputs and outputs attached to the Setup page have characteristics that can be modified in a similar way. To find out more, see the *Reference Guide*.

Now the temperature sensor attached to port 4 displays its responses in degrees Fahrenheit.

You have placed the temperature sensor on the Setup page, tested it and set the measurement to degrees Fahrenheit.

Next, you will learn to use the temperature sensor feedback to control the fan.

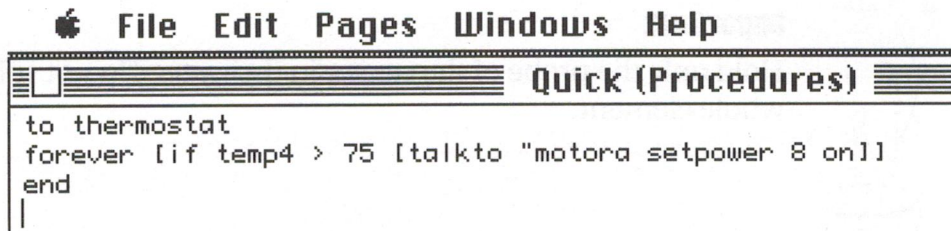


## Controlling the Fan Motor with the Temperature Sensor

You can use the temperature sensor feedback to control when the fan motor turns on and off. For example, the `thermostat` procedure below checks the temperature sensor continuously. If the temperature goes above 75° F, the motor turns on.

- Type the `thermostat` procedure on the Procedures page but use a number that corresponds to your temperature sensor feedback.

Remember the temperature values used in the examples may not be appropriate in your procedures. Make sure you enter temperature values that are meaningful in your situation or the fan will not respond properly.



The screenshot shows a menu bar with the Apple logo and the words 'File Edit Pages Windows Help'. Below it is a window titled 'Quick (Procedures)' with a scroll bar. The window contains the following code:

```
to thermostat
  forever [if temp4 > 75 [talkto "motora setpower 8 on]]
end
```

- Turn off the fan motor and stop the `forever` process by typing `stopall` in the Command Center.

### Challenge 3

- Modify the `thermostat` procedure so the fan turns off automatically when the temperature cools.

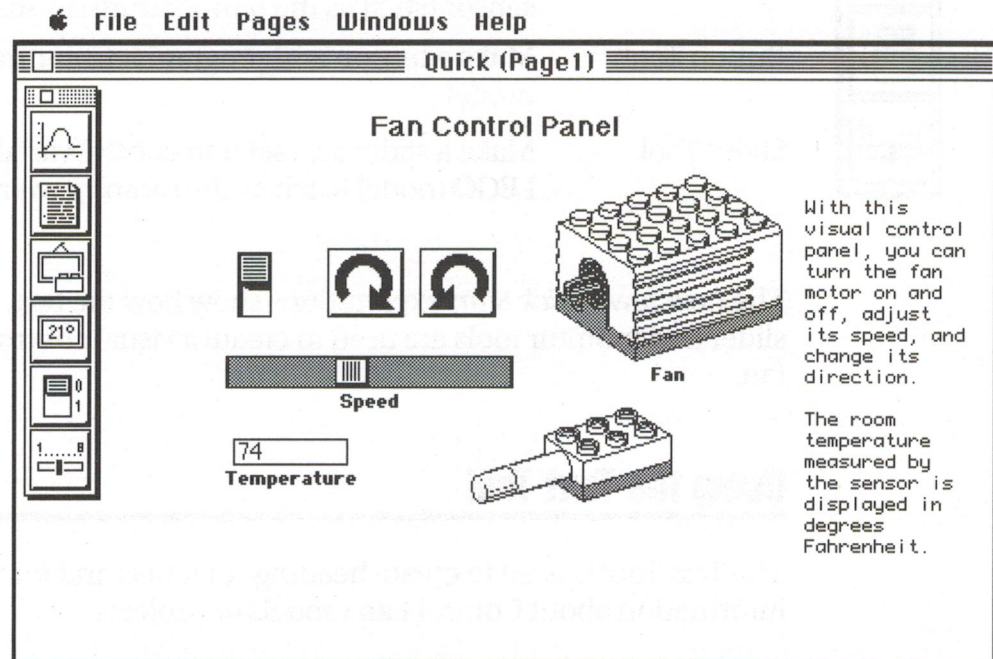


# Creating a Project Page

For any project in LEGO DACTA® Control Lab, you can develop project pages for:

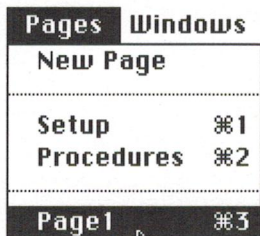
- documenting your work
- showing pictures of the models
- monitoring sensor feedback
- graphing results
- developing point and click buttons and sliders to control your models (a visual “control panel”)

For example, a project page for the fan might look like this.



Follow the next few exploration activities and complete the Challenges to create a project page like this for your fan.

- Select Page1 from the Pages menu to access a project page.







On the left side of the screen is the Tools Palette. With the Tools you can:

- |              |   |
|--------------|---|
| Graph Tool   | Make a graph box and graph the results from the sensors (such as temperature changes over time.)      |
| Text Tool    | Make a text box and enter text.   |
| Picture Tool | Make a picture box and select shapes (such as a motor) provided on the LEGO DACTA® Control Lab disk.  |
| Monitor Tool | Make a monitor box and display the current state of a sensor (such as the temperature sensor value.)  |
| Button Tool  | Make a button and program it to control a LEGO® model.  |
| Slider Tool  | Make a slider and set it to control variable output for a LEGO model (such as the motor power level.) |

The next few *Quick Start* explorations show how the text, picture, button, slider and monitor tools are used to create a visual control panel for the fan.

## Using the Text Tool

The Text Tool is used to create headings or labels and for writing information about Control Lab models or projects.

To create a heading for the fan project page, follow these steps.



- Click on the Text tool once.

It changes color to indicate that it has been selected.

- Move to the top of Page1.

The cursor changes to a cross hair.

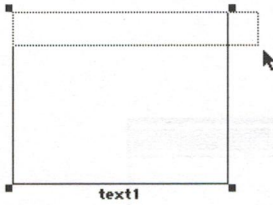
- Click the mouse button once.

A box named `text1` appears. Square black “handles” appear in the corners to indicate the `text1` box is selected.

You now have an empty text box but the box is too large for a heading.

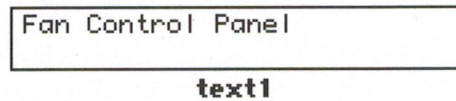
If you click on the wrong tool, just point to the correct tool on the Tools Palette and click the mouse button. If you want to deselect a tool, just click on the selected tool again.





► Make the box narrower by dragging one of the black square handles upward.

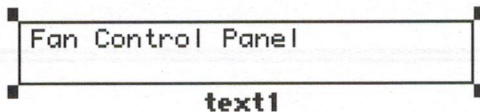
► Click outside the text box to deselect it. Then click in the text box and begin typing.



The text box frame and name `text1` interferes with easy reading of the text.

► To modify the text appearance, select the `text1` box by holding down the Shift key and clicking anywhere inside the `text1` frame.

Small black squares or “handles” appear in the corners.



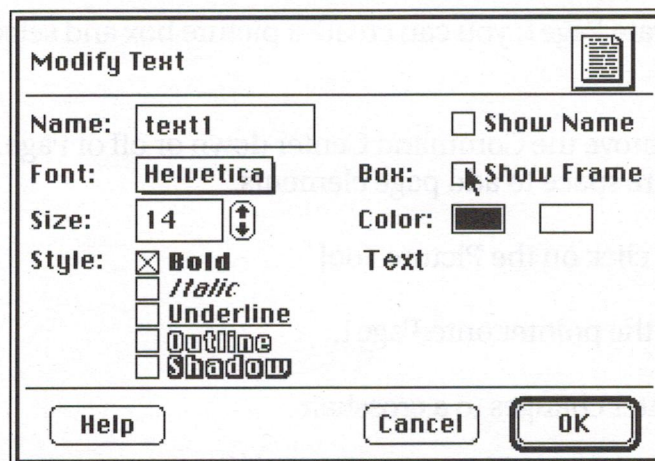
► Now double-click inside the `text1` frame to open a dialog box.

### Macintosh users:

You can select a font type, size and style in the text dialog box. The fonts available depend upon what fonts are loaded into your computer system.

### MS-DOS users:

Font type, size and style are not options in LEGO DACTA® Control Lab.



► Click in the Show Name and Show Frame boxes to eliminate the name `text1` and the frame around the heading text.

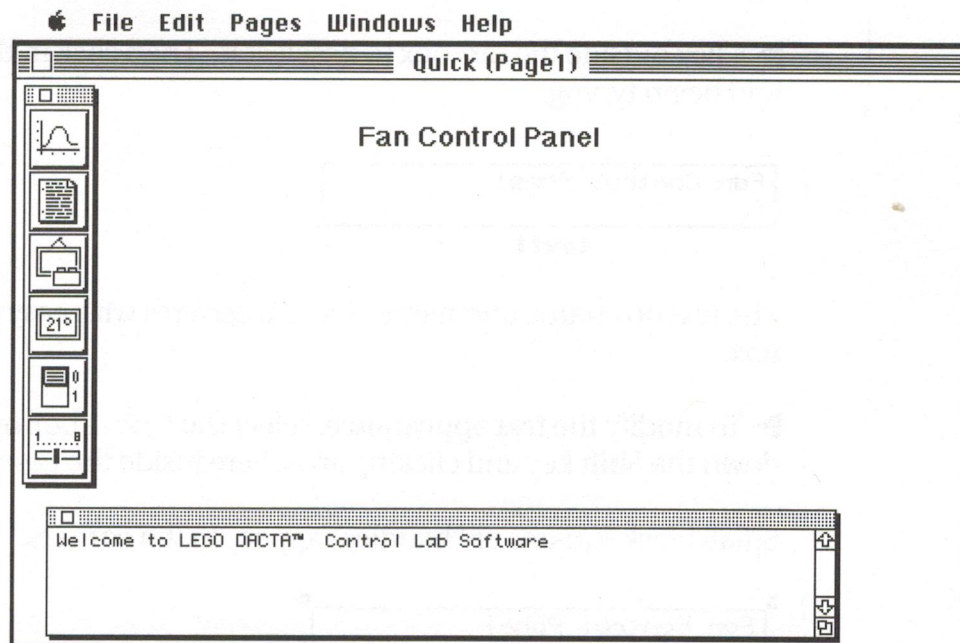
► Click OK.



The heading is complete.

To erase items from a project page, hold down the Shift key and click on the item to be erased. The item is highlighted by small black squares called "handles" at each corner. Select Clear from the Edit menu.

You can also press the Delete or Backspace key on your keyboard to eliminate a selected item.



## Using the Picture Tool

Click on the top grey line and drag the Command Center off the page. You can also select Command Center in the LEGO DACTA® Control Lab Windows menu or use the shortcut keys, ⌘-D (Macintosh) or Alt-D (MS-DOS).



To illustrate Page1, you can create a picture box and select a motor shape.

► First, move the Command Center down or off of Page1 so that you have more space to add page elements.

► Then, click on the Picture Tool.

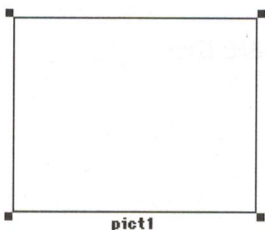
► Move the pointer onto Page1.

The pointer changes to a crosshair.

► Click the mouse.

A picture frame labelled `pict1` appears.

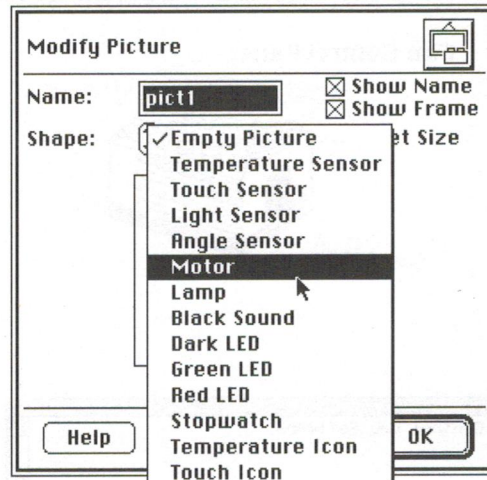
► Double-click inside the `pict1` frame to open the dialog box.





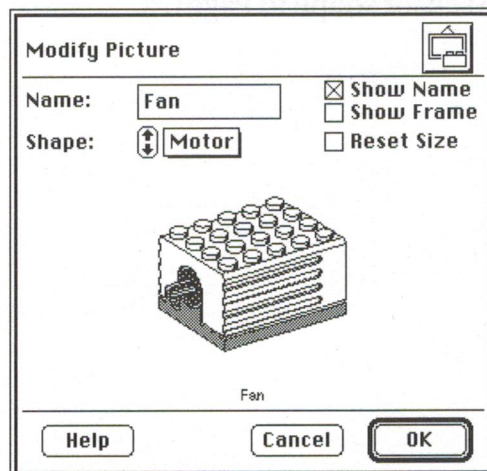
- Click on the Shape popup menu and select Motor.

The motor shape is placed in the picture frame.



- Change the default name pict1 to Fan.

- Click on the box next to Show Frame to eliminate the picture frame around the motor shape.



- Click OK to close the dialog box and return to Page1.



You can move the motor shape around on the screen by selecting it (shift-click) and then dragging it to another position.

### Macintosh users:

To resize the motor shape, select it, then drag on one of the four black "handles" to adjust the picture frame size. If you are not happy with the modified size, you can reset the motor shape back to its original size by opening the dialog box (shift-double-click) and clicking in the Reset Size box.

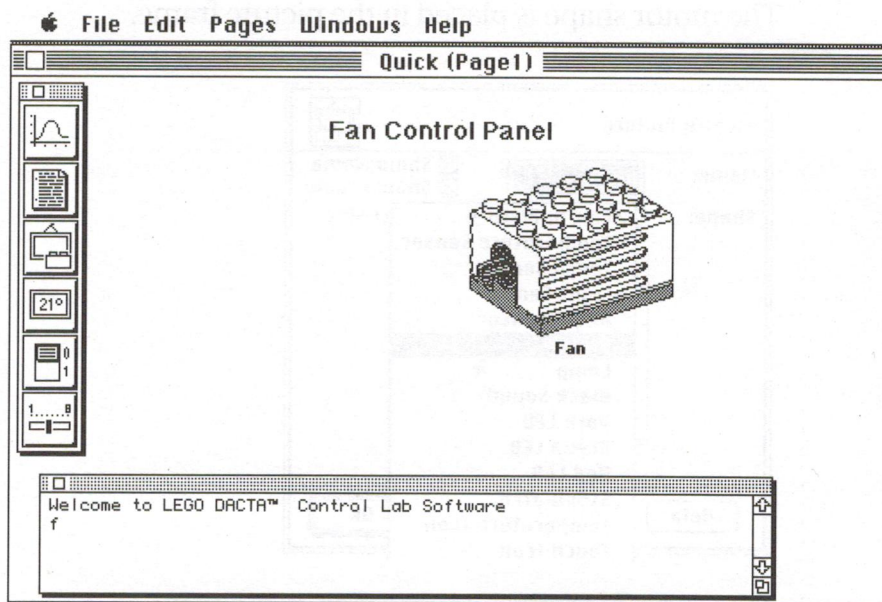
### MS-DOS users:

Picture shapes cannot be resized in LEGO DACTA® Control Lab.

### Teacher note:

The project illustrations throughout the *Quick Start Guide* assume students have completed the Challenges.

You have added a motor illustration named Fan to the Fan Control Panel.



## Challenge 4

► Add a temperature sensor shape to Page1.



## Using the Button Tool

You can create a button on the screen to turn on and turn off the motor.



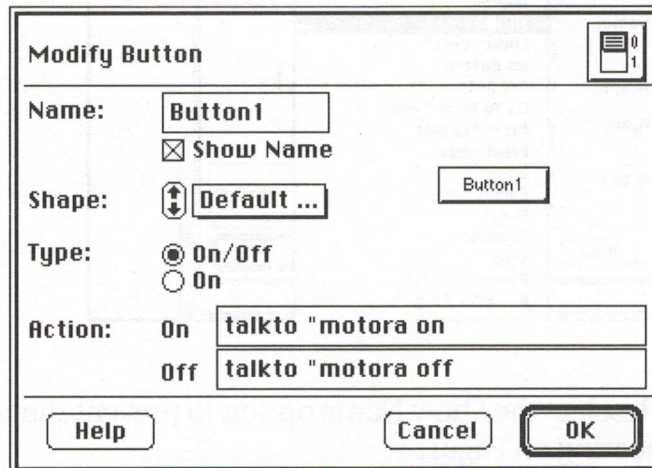
- Click on the Button Tool.
- Move the pointer to a clear space on Page1.

The pointer changes to a crosshair.

- Click the mouse.

A button named `button1` appears.

- Open the dialog box for `button1` (double-click).
- Enter the commands shown in the Action: On and Action: Off fields.



- Click OK to return to the Page1.
- Click on `button1`. What happens?

The fan motor in port A turns on because the Action: On commands are run by Control Lab when `button1` is clicked. Notice also that `button1` changes color.

- Click `button1` again.

The fan motor in port A turns off and the button changes back to its original color. The second click causes Control Lab to run the Action: Off commands.

If you accidentally press Return or Enter and close the dialog box before you are done, shift-double-click on `button1` to open the dialog box again.

If the fan motor did not turn on, make sure it is attached to output port A on the LEGO DACTA® Serial Interface. Also, check the commands typed into the dialog box to make sure the commands and spacing are correct.

## Experienced Logo users:

You can write a procedure to control the fan. Type the name of the procedure in the Action: On field. Then go to the Procedures page and write a procedure with that name. Another procedure can be developed for the Action: Off field, or that field can remain blank.

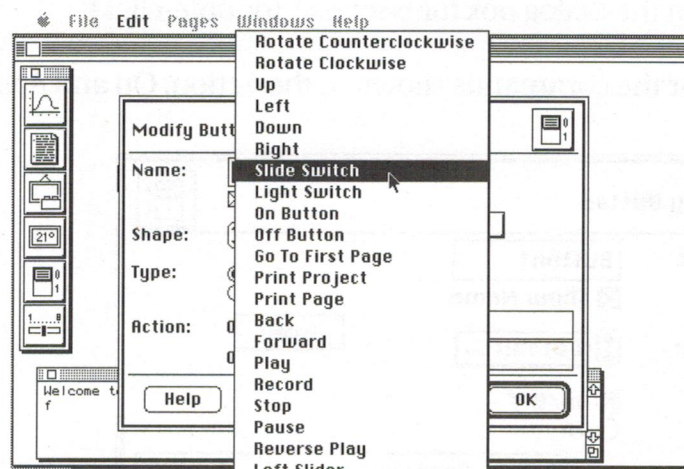
You can modify the plain, square button by choosing a different shape in the button dialog box.

► Open the dialog box (shift-double-click on `button1`).

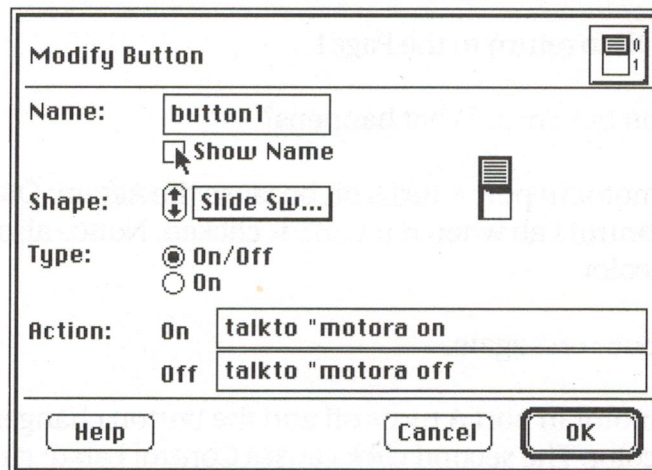
► Click and hold on the word Default next to Shape.

A popup menu appears.

► Drag the pointer up until you see Slide Switch. Select Slide Switch and release the mouse button.



► Then deselect the Show Name option to prevent the name `button1` from appearing on Page1.



► Click OK to close the dialog box. Click the button to turn on the motor.

Notice that the appearance of the button shape changes.



- Click the button again to turn off the fan motor.

You have created an on-screen button to turn on and turn off the fan motor.

## Changing the Type of Button

There are two “types” of buttons that can be created.

- Open the dialog box to see the options (shift-double-click on the Slide Switch button).

The “Type” selected determines how the Action: On and Action: Off instructions are interpreted.

The On/ Off rule used in previous explorations ran the Action: On instructions the first time the button was clicked. The Action: Off instructions were run the next time the button was clicked.

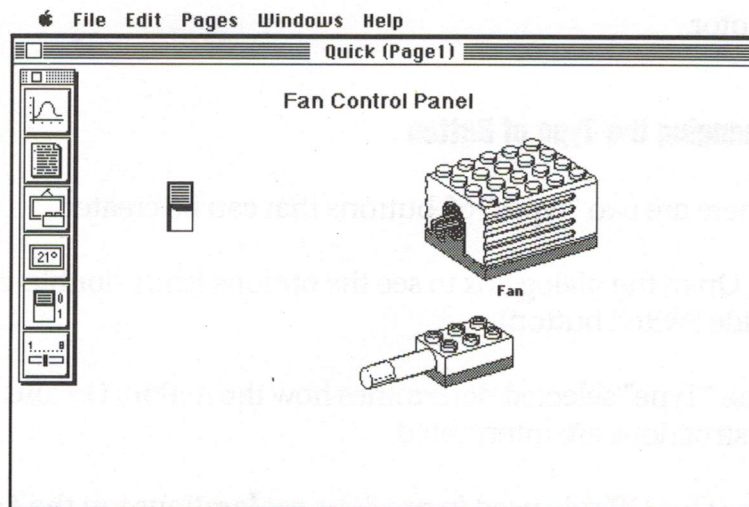
The Type: On option works differently. It runs the Action: On commands while the mouse button is pressed down on `button1` and runs the Action: Off commands when the mouse button is released.

- Click in the Type: On circle so that the motor turns on while the mouse button is pressed on `button1` and stops running when the mouse button is released.

The screenshot shows a 'Modify Button' dialog box. The 'Name' field is set to 'button1'. The 'Shape' is set to 'Slide Sw...'. The 'Type' section has two radio buttons: 'On/Off' and 'On'. The 'On' radio button is selected. The 'Action' section has two text boxes: 'On' with the text 'talkto "motora on"' and 'Off' with the text 'talkto "motora off"'. At the bottom are 'Help', 'Cancel', and 'OK' buttons.

- Click OK to close the dialog box. Then click the Slide Switch button to activate it.

The fan motor turns on while the mouse button is down and turns off when the mouse button is released.



The next activity, “Creating Buttons for Directional Control,” shows another example using the Type: On option.

For future uses throughout the *Quick Start Guide*, the Type: On / Off option is a better choice for turning on and turning off the motor. So, change the button type again.

► Open the `button1` dialog box and click in the Type: On / Off circle.

► Then click OK to see Page1.

► Click once on `button1`.

The motor turns on.

► Click on `button1` again.

The motor turns off.

### Creating Buttons for Directional Control

LEGO DACTA® Control Lab Logo commands `setright` and `setleft` control the direction a motor turns. You can create buttons to set the fan motor direction.

► Create a button by clicking on the Button Tool and then clicking in an open area of Page1.

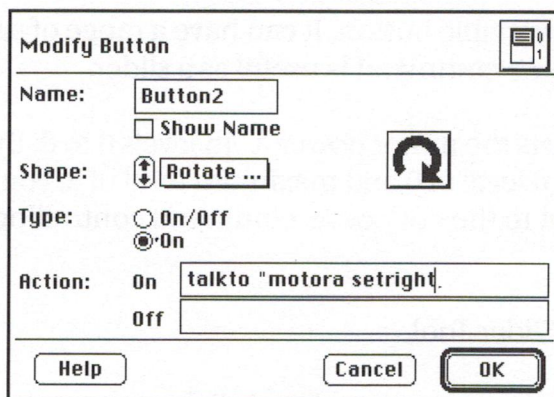
If the motor does not turn on and off, check the dialog box to make sure the information in the dialog box is changed back to the original setting on page 29. Also check to make sure the fan motor is attached to output port A and the power to the LEGO DACTA® Serial Interface is on.



The `setright` command does not turn the motor on, it simply sets the direction of rotation. Therefore, no Action: Off information is needed.

A button named `button2` appears.

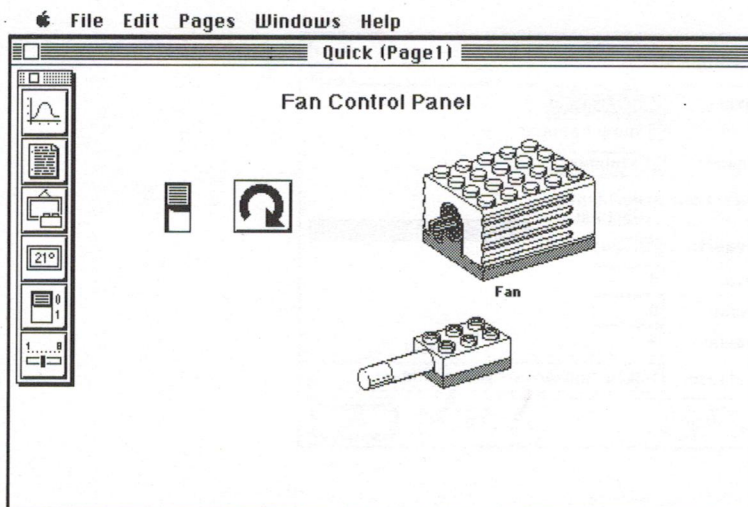
- ▶ Double-click `button2` to open the dialog box.
- ▶ Click in the box next to Show Name so the name `button2` does not appear on Page1.
- ▶ Choose the Rotate Clockwise shape from the Shape popup menu.
- ▶ Change Type to On by clicking in the circle.
- ▶ Type the commands as shown in the Action: On field.



- ▶ Click OK to see the project page.
- ▶ Click on the `setright` (clockwise) button, then click on the Slide Switch button to turn on the fan.

The fan motor turns on in the clockwise direction.

If the motor did not turn on in a clockwise direction, make sure the motor is attached as shown in the fan drawing on page 7. The polarity of the motor (direction) is affected by the position of the wire connector on the output port. For more information, see Exploration 1 in the *Setup Guide and Introductory Explorations* book.



## Experienced users:

Use copy and paste in the Edit menu to copy the clockwise button. Then modify the dialog box of the copied button to make a counterclockwise button.

### Teacher note:

The steps for copying and pasting the button are described in the suggested solution for Challenge 5 on page 51.



The `setpower` command requires one input: a number from 0 to 8. In the Release area, the input to `setpower` is `slider1`. That means the position of the `slider1` knob inputs a number to the command `setpower`.

The range of values for the slider are set by the Min and Max fields. When the knob is moved to the far left of the slider, the Value is set at the Minimum level. When the knob is positioned on the far right, the Value is set at the Maximum level.

## Challenge 5

- Create a new button to turn the motor counterclockwise.

The counterclockwise button is similar to the clockwise or `setright` button.

## Using the Slider Tool

You can create a slider to control the power level setting of the motor.

A slider is like a variable button. It can have a range of settings. That is why the `setpower` command is useful as a slider.

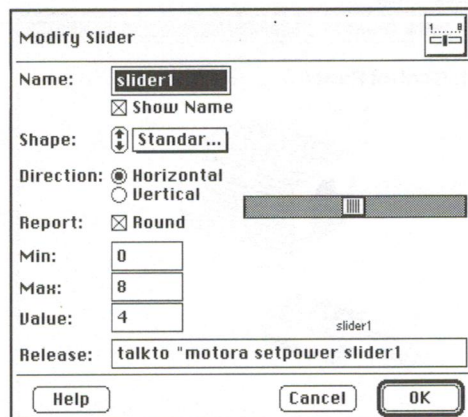
`Setpower` adjusts the motor power from levels 0 to 8. By creating a slider with a minimum level of 0 and maximum level of 8, you can have an adjustable input to the `setpower` command controlling the fan motor in port A.

- Click on the Slider Tool.
- Move to an open area of Page1 and click.

`Slider1` appears. Double-click to open the dialog box for `slider1`.

- Enter the commands shown in the Release field of the dialog box.

The value of Min is 0 and Max is 8, which are the correct minimum and maximum values for `setpower`, so you do not need to change them.



**Modify Slider**

Name:  ☒ Show Name

Shape:

Direction: ☒ Horizontal ☐ Vertical

Report: ☒ Round

Min:

Max:

Value:  slider1

Release:



You may wish to modify other features of the slider such as Direction and Shape. Choosing these options for the slider is similar to previous Tools.

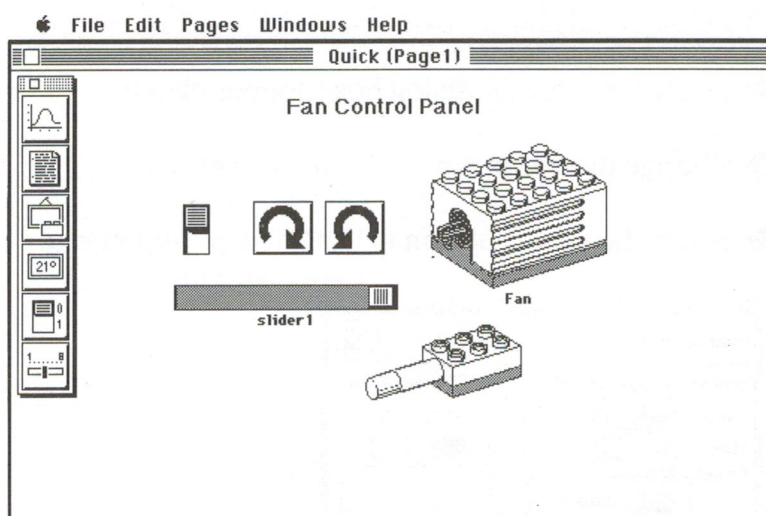
► Click OK to close the dialog box.

► Use the mouse to move the `slider1` knob. Then click the Slide Switch button to turn on the fan.

► Try the `slider1` knob in several positions while the fan motor is running. What happens to the motor speed?

The motor increases or decreases its speed depending upon the position of the `slider1` knob.

You now have a Fan Control Panel that can turn the motor on and off and set the speed and direction of the fan motor.



The next explorations show how sensor input can be monitored and graphed.

### Challenge 6

► Change the name from `slider1` to `Speed` to better indicate what the slider controls.

## Using the Monitor Tool

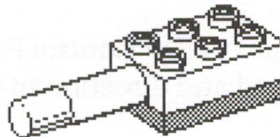
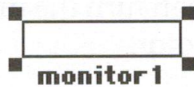
The Monitor Tool can be used to display readings from the LEGO DACTA® Control Lab sensors. You can create a Monitor to show the temperature measured by the sensor attached to input port 4.



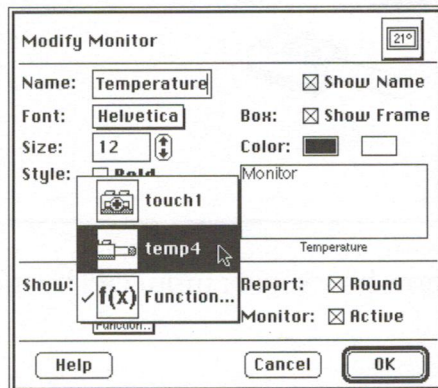
See Challenge 4 on page 50 if you do not have a temperature sensor shape on Page1.

- Click on the Monitor Tool.
- Then click in the open area next to the temperature sensor shape.

A box labelled `monitor1` appears.



- Open the monitor dialog box (double-click).
- Change the name `monitor1` to `Temperature`.
- Select the `temp4` option in the Show popup menu.



- Click OK.

The temperature sensor state is displayed in the monitor box labelled `Temperature`.

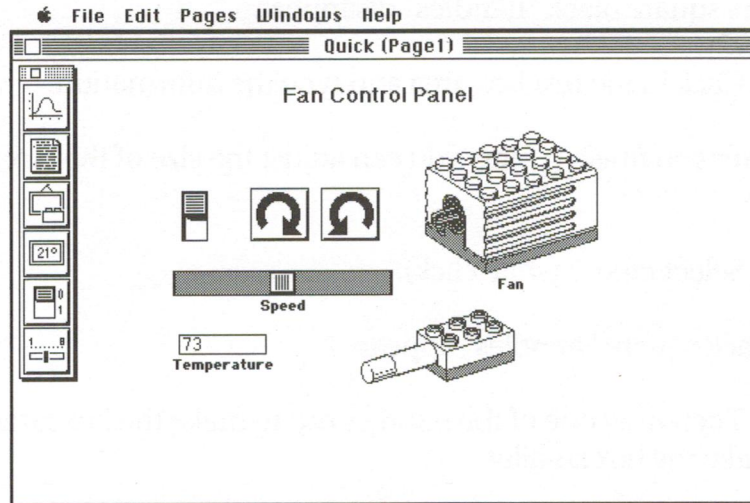
- Dip the temperature sensor probe in warm or cold tap water or rub the probe on your hand. What happens in the monitor?

The monitor box shows the temperature change.

`Touch1` and `temp4` appear in the popup menu because previously you placed the touch sensor icon and temperature sensors on the Setup page input ports. If you do not see these options in the popup menu, go back to the Setup page and drag the touch sensor icon to input port 1 and the temperature sensor icon to input port 4. The explorations in this book also assume the temperature sensor is set to measure in degrees Fahrenheit. See page 21 for more information.

If you wish to see decimal values for temperature in the monitor box, deselect the Round option in the monitor dialog box.





### Macintosh users:

You may wish to change the type font, size or style in the monitor dialog box.

### MS-DOS users:

You cannot change the type of font, size or style in the monitor dialog box.

The Fan Control Panel is nearly complete. Try the next activity to make your fan system easier to understand and use.

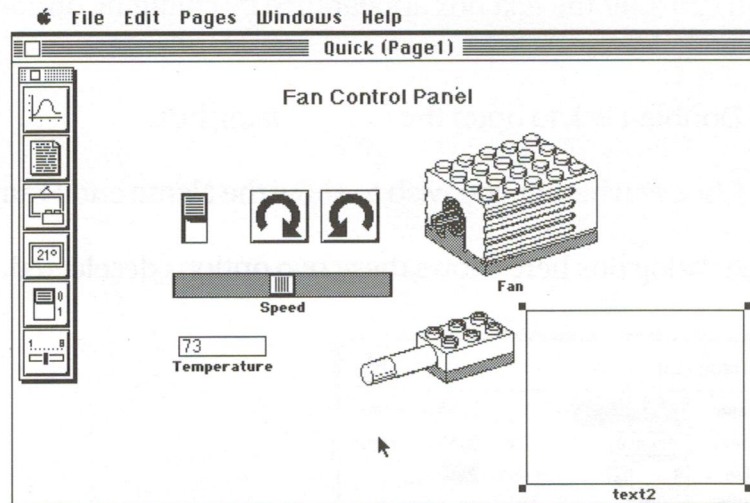
## Adding Text to Document Your Work

Add a text box to explain the features of the Fan Control Panel.

► To begin, click on the Text Tool. Then move to the right hand portion of the Fan Control Panel and click.

The heading "Fan Control Panel" is in `text1`.

A box named `text2` appears.



► Click outside the text box to deselect it.

The square black “handles” disappear.

► Click in the text box area and type the information.

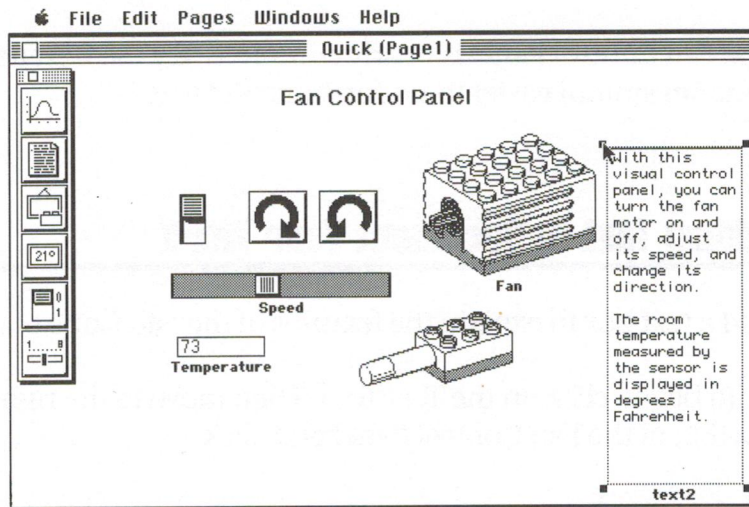
After you finish typing, you can adjust the size of the box to better fit the text.

► Select `text2` (shift-click).

Black square “handles” appear.

► Then drag one of the handles out to make the box larger or in to make the box smaller.

You can scroll through the text in the text box. Just click in the text box and use the arrow keys on the keyboard to move up and down the lines of text or over and across individual characters.



You can alter the text box appearance by changing options in the dialog box.

► Double-click to open the `text2` dialog box.

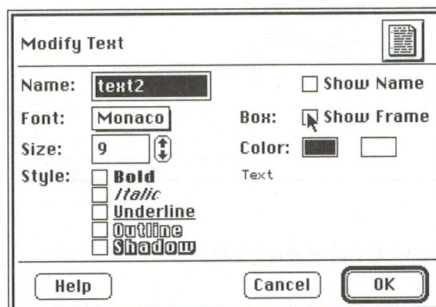
► Choose whether you wish to show the Name and Frame.

The dialog box here shows these two options deselected.

If the text box is not selected, then shift-double-click.

### Macintosh users:

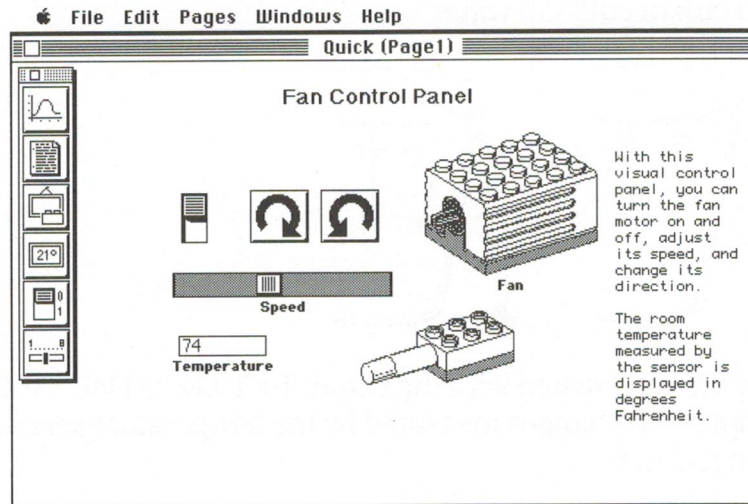
Select the font, size and style of text you wish.





► Click OK to get back to Page1.

The final Fan Control Panel looks like this.

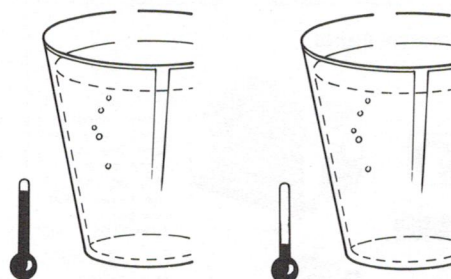


You have learned to use the Text, Picture, Button, Slider and Monitor Tools. The next activity explains how to use the Graph Tool to gather data from the sensors.

## Using the Graph Tool

For this activity, you need these materials along with the fan and temperature sensor.

- a cup of warm tap water
- a cup of cold tap water



On a graph created with the Graph Tool, LEGO DACTA® Control Lab can display the changes measured by the temperature sensor as time passes (“in real time”).

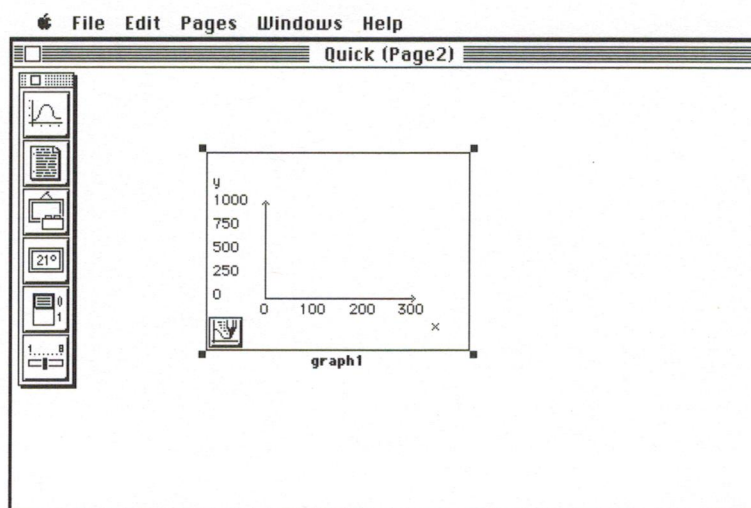
You can add a graph to any project page. However, for this exploration you need a lot of space, so put the graph on a separate page.

Pages Windows  
New Page



- ▶ Create a new page by selecting New Page from the Pages menu.
- ▶ Click on the Graph Tool.
- ▶ Move the pointer onto Page2 and click.

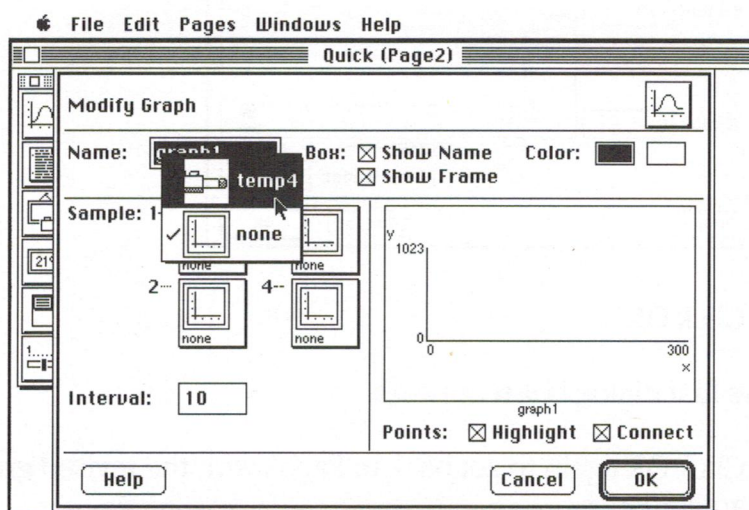
A box labelled `graph1` appears.



- ▶ Double-click on `graph1` to open the dialog box.

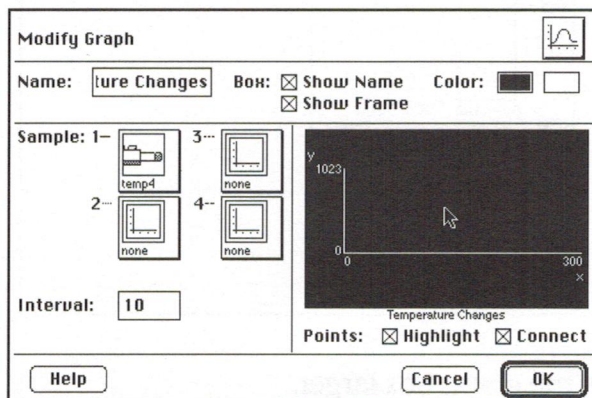


- Click and hold on the graph labelled 1 in Sample. Select `temp4` from the popup menu.



- Change the name of the graph by typing `Temperature Changes` in the Name field.

- Now click on the graph area shown in the dialog box.



Another dialog box appears.

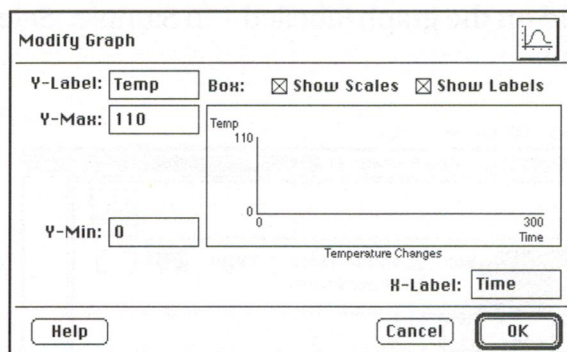
- Change the Y- Label to `Temp`.

Change the Y-Max (maximum value for the Y axis) range from 1023 to 110 to set a more reasonable range for Fahrenheit temperature.

- Change the X-Label to `Time`.

The LEGO DACTA® Control Lab temperature sensor can report a range from -4 to +140° F or -20 to +50° C.

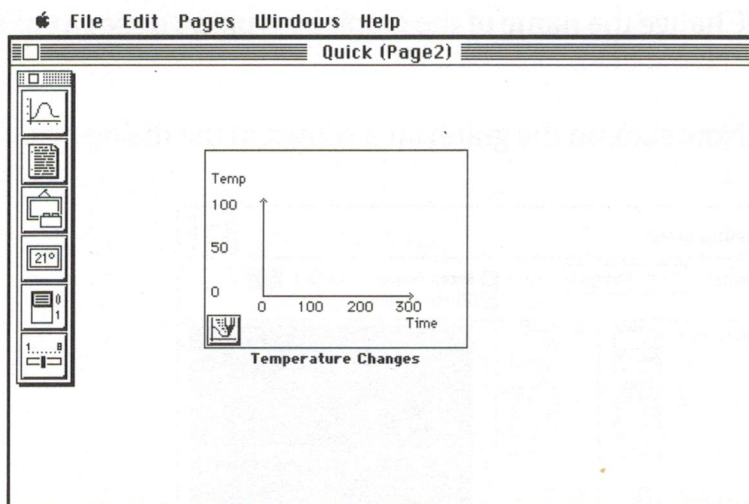
LEGO DACTA® Control Lab automatically samples the temperature data every second. (Interval in the first graph dialog box is set to 10 which is 1 second.) To change the sampling interval, click in the Interval box and change 10 to the number you prefer. For example, if you wish to collect data once every minute, type 600.



► Click OK.

The first dialog box reappears.

► Click OK again to get back to Page2 with the revised graph characteristics.



You can make the graph box larger.

► Shift-click to select it. Then drag one of the handles out to enlarge it. Click outside the graph box to deselect the graph box.

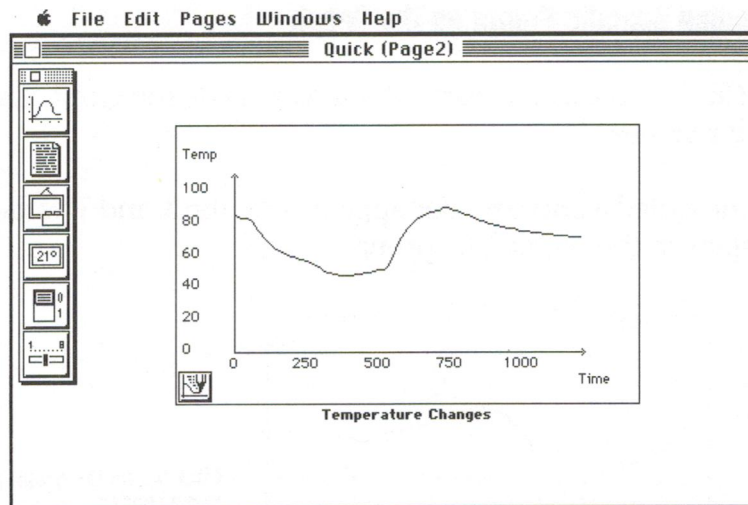


► Now, click the small graph icon on the lower left of the graph to begin gathering data from the temperature sensor.

The graph icon changes and the graph begins displaying the temperature data.

► Move the temperature sensor in and out of the glasses of warm and cold tap water. Observe the temperature changes shown on the graph.





The graph dips down when the temperature cools and slopes upward as the temperature rises.

The graph automatically rescales the x-axis when it reaches the maximum value.



► Click the graph icon again to stop gathering data.

The maximum number of samples for a LEGO DACTA® Control Lab graph is 3000. Up to four different inputs can be graphed on the same graph.

### Experienced Logo users:

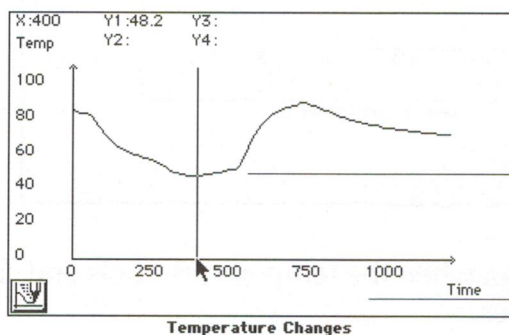
`Startsample` and `Stopsample` are Control Lab commands that start and stop the collecting of data.

The graph icon changes color and data collection stops.

## Reading Specific Points on the Graph

- Click on a specific point of interest inside the graph area to see the X and Y values.

A line called a curve reader appears and the X and Y values for the graph display in the upper left corner.



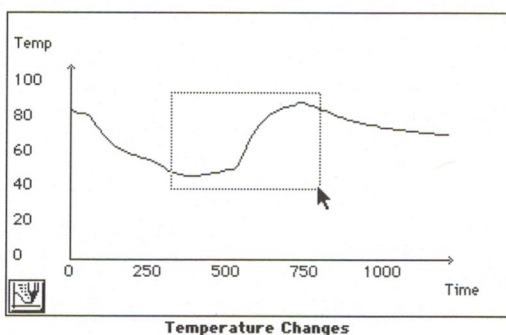
Click inside the graph area to show the curve reader.

Click outside the graph area to eliminate the curve reader.

- To eliminate the curve reader, click in the graph box outside the X and Y axis range.

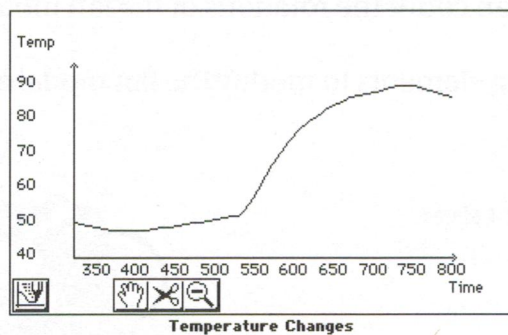
## A Close Up Look at Graph Data

- To see a smaller part of the graph, select an area by dragging a box around it.



The graph area changes to a close up view and some additional tools appear.





With the grabber hand you can adjust the range of data shown.

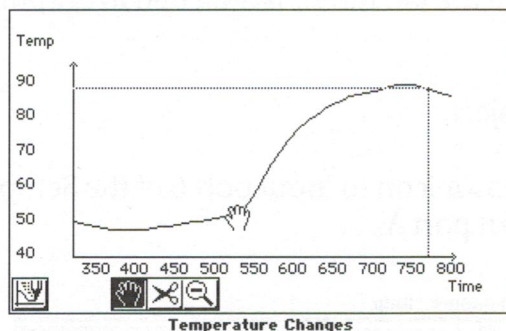


► Click on the grabber hand icon once. Then move the grabber hand to the graph, hold down the mouse button and move the grabber hand around on the graph.

The data inside the close up window changes as you move the grabber hand in any direction.

The curve reader also works in the close up view.

If you have cut the graph with the scissors, you are back in the full graph view and the scissors, grabber hand and magnifying glass tools are not visible. To see them again, select an area of the graph by dragging a box around it.



The scissors “cut” the data, allowing you to eliminate all the data except that shown in the close up view.

### Important:

Do not use the scissors unless you wish to eliminate data from the larger graph!



► Click on the magnifying glass to return to the larger graph (assuming you did not cut the graph with the scissors).

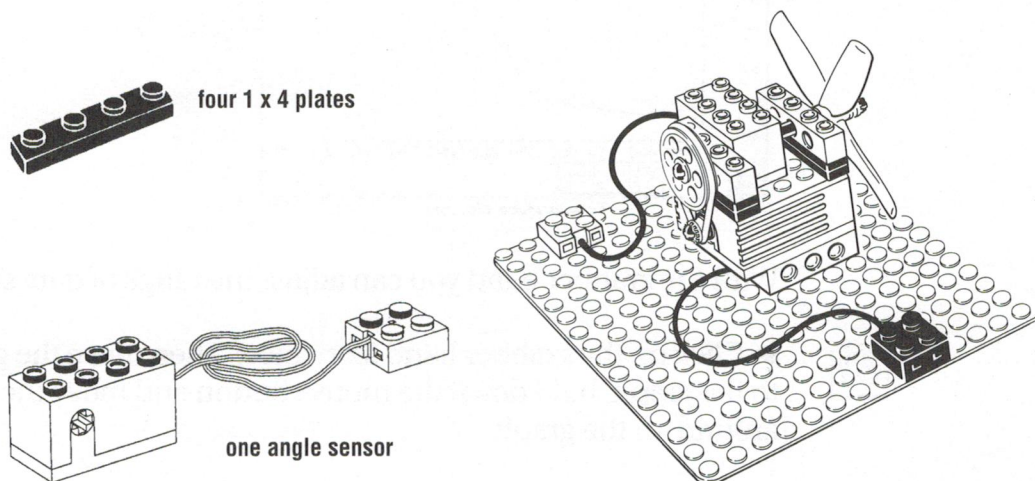
Congratulations! You have learned to use all of the Tools on the Tools Palette.

Now you are ready to apply the skills you have learned to more open-ended problem solving activities. Five such projects are included in the *Technology Investigations and Inventions* book.

## Appendix A. Using the Angle Sensor

The angle sensor can count the rotations of the fan motor.

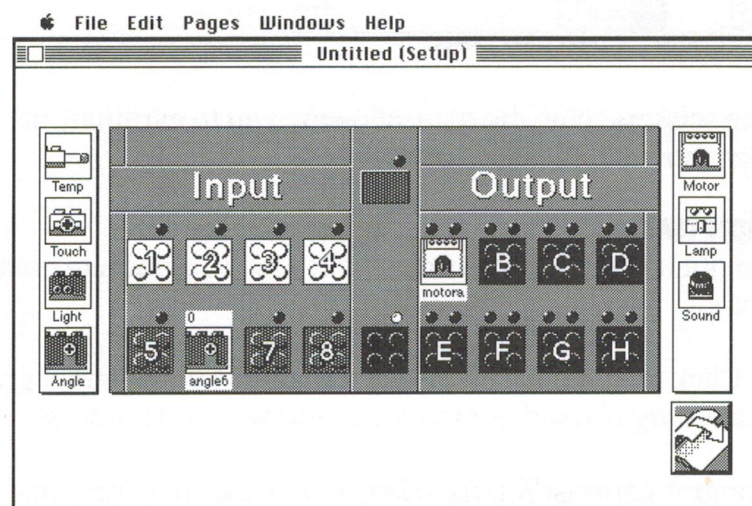
► Use the following elements to modify the fan model as shown.



► Attach the angle sensor to input port 6 of the LEGO DACTA® Serial Interface. Make sure the fan motor is attached to output port A of the interface.

► Create a new project.

► Drag an angle sensor icon to input port 6 of the Setup page. Drag a motor icon to output port A.



The angle sensor may not be able to collect all data when the motor runs at higher speeds. The maximum rate at which angle sensor data can be collected is 500 RPM.

► Click and hold the left circle above port A to turn on the motor in the left or counterclockwise direction. As the motor runs, observe the numbers above the angle sensor icon in port 6.

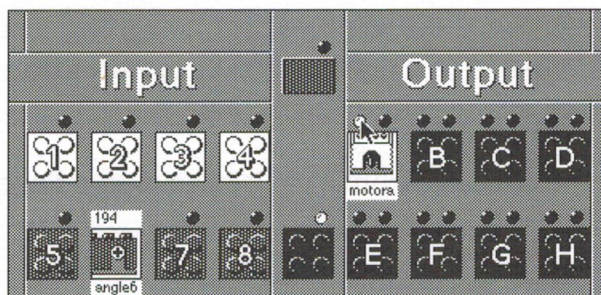


The way the wire connectors are placed on the ports affects the direction the motor turns. To reverse the motor direction, flip a connector on one end of the wire 180°. See Exploration 1 in the *Setup Guide and Introductory Explorations* book for more information.

The numbers indicate the rotations the angle sensor measures. The angle sensor counts 16 for each rotation of the axle inserted through the sensor. A value of 32 indicates two complete rotations. A value of 33 indicates two plus 1/16 th rotations.

The fan moves very quickly and may not reverse direction exactly when `angle 6` equals 1000 and stop exactly when it equals 0. Use `>` and `<` in the procedure to avoid this problem.

The numbers increase as the motor moves.



At full speed the angle sensor values change very quickly.

► Set the fan to a lower speed by typing `setpower 2` in the Command Center.

► Now click and hold the circle on the right above the motor.

The motor turns on in the right or clockwise direction and the numbers above the angle sensor in port 6 decrease.

► The command `resetrotation` resets the angle sensor value back to 0. Try it!



The angle sensor value above `angle6` on the Setup page resets to 0.



► Save the fan with angle sensor project as FanAngle.

## Challenge 7

► Go to the Procedures page and write a procedure that uses feedback from the angle sensor to control the movement of the fan motor. Program the fan motor to reverse direction when `angle6` reaches 1000 and to stop when `angle6` returns to 0.

## Appendix B. Printing Projects and Pages

- ▶ To print all of the pages in a project, choose Print Project from the File menu.
- ▶ Respond as needed to the dialog box or prompts from the computer system to complete the printing task.
- ▶ To print a specific page from a project, go to that Page by selecting it from the Pages menu.
- ▶ Then select Print Page from the File menu.

File	Edit	Pages	Win
New Project			⌘N
Open Project...			⌘O
Close Project			⌘W
Save Project			⌘S
Save As...			
Preferences			
Printer Setup...			
Print Project			⌘P
Print Page			
Quit			⌘Q

### Experienced Logo users:

Printpage, Printproject and Printtext are LEGO DACTA® Control Lab commands that can be used to print all or part of your project. See the alphabetical listing of primitives in the *Reference Guide* for examples of each.



## Appendix C. Challenge Solutions

The solutions given to all the Challenges are only suggestions. Other solutions are possible.

### Challenge 1 Page 13

► Using the commands you have learned, put together your own sequence to turn on the fan for one minute, reverse the direction and turn it on for another minute.

The timer runs in tenths of seconds so onfor 600 is 600/10 or 60 seconds.

```
talkto "motora onfor 600 rd onfor 600
```

Acceptable setpower inputs are between 0 and 8 inclusive. The highest power is 8, the lowest is 0.

### Challenge 2 Page 19

► Change the fan procedure so the fan runs for a few seconds at a high power level and then runs for a few seconds at a low power level.

```
File Edit Pages Windows Help
Quick (Procedures)
to two.speed.fan
waituntil [touch1]
talkto "motora
setpower 8
onfor 20
setpower 3
onfor 20
end
```

### Challenge 3 Page 22

► Modify the procedure so the fan turns off automatically when the temperature cools.

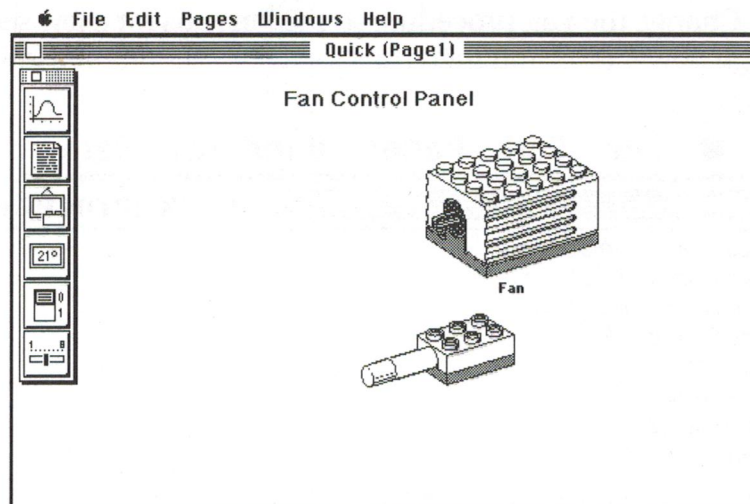
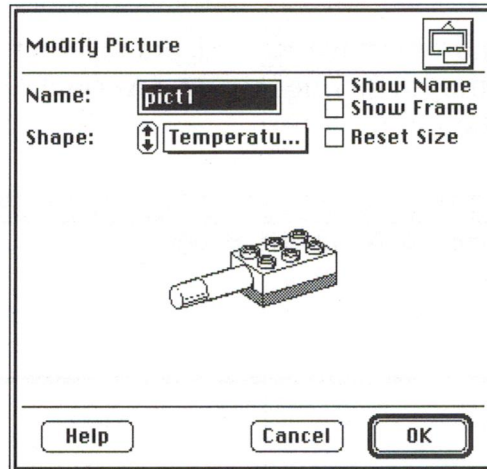
The temperature values shown assume the temperature sensor is measuring in Fahrenheit. The fan turns on when the temperature goes above 75 °F and turns off after the temperature drops below 73 °F.

```
File Edit Pages Windows Help
Quick (Procedures)
to thermostat
forever [if temp4 > 75 [talkto "motora setpower 8 on]]
forever [if temp4 < 73 [talkto "motora off]]
end
```

## Challenge 4 Page 28

- Add a temperature sensor shape to Page1.

The solution shows the Temperature Shape selected, Show Name deselected and Show Frame deselected.

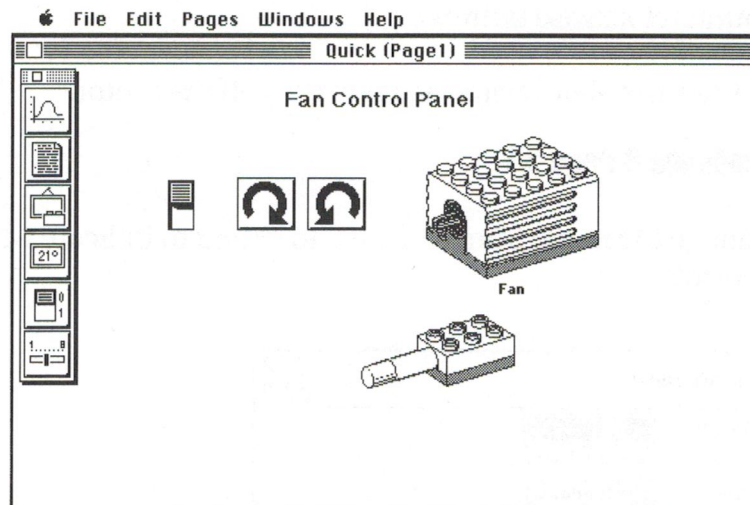
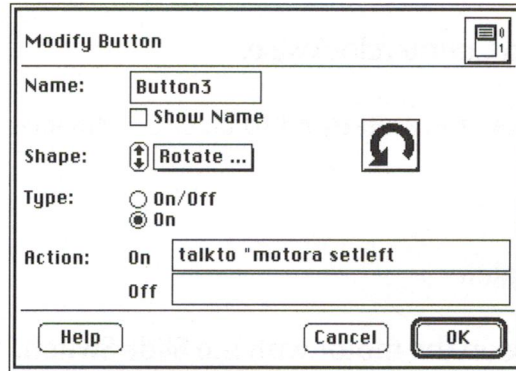




## Challenge 5 Page 34

The solution shows the Rotate Counterclockwise shape selected, Show Name deselected, the Type: On selected and setleft command used to set the motor in the counterclockwise direction.

- Create a counterclockwise button, similar to the clockwise (setright) button.



### Copying and Pasting a Button

You can create the counterclockwise button using the button tool; or, you can follow the steps below to use copy and paste to create the counterclockwise button.

- Select the clockwise button (shift-click).

Handles appear at the corners.

- Select Copy from the Edit menu.

The button is copied into the computer's clipboard memory.

- Select Paste from the Edit menu.

A copy of the button appears on the page.

- ▶ Drag the button to an open space on the page.
- ▶ Open the dialog box of the new button.
- ▶ Change Shape to Counterclockwise.
- ▶ Change the Action: On statement to talkto "motora setleft.
- ▶ Click OK.

The button is complete.

- ▶ Test it by turning on the motor with the Slide Switch. Then change the direction of the motor by clicking the clockwise and counterclockwise buttons.
- ▶ Click the Slide Switch again to turn off the motor.

### Challenge 6 Page 35

Change the name from slider1 to Speed to indicate what the slider controls.

Modify Slider

Name:

☒ Show Name

Shape:

Direction: ☒ Horizontal ☐ Vertical

Report: ☒ Round

Min:

Max:

Value:  Speed

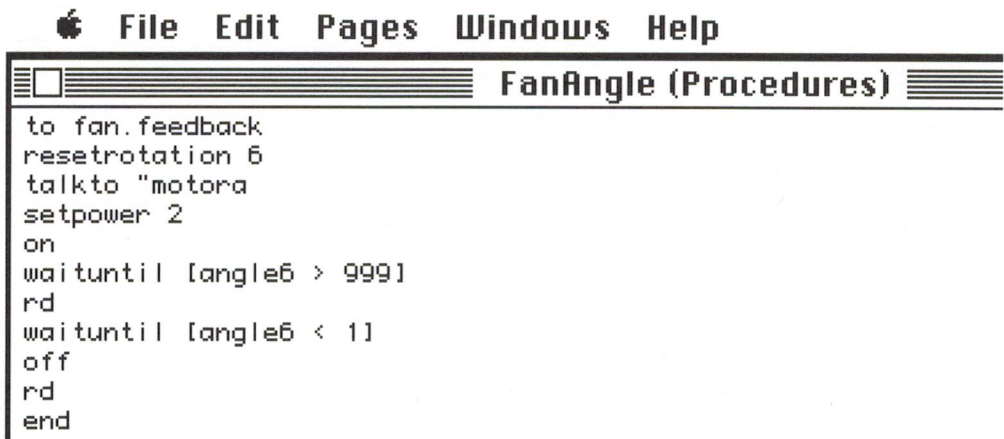
Release:



---

### Challenge 7 Page 47

- Write a procedure that uses feedback from the angle sensor to control the movement of the fan motor. Program the fan motor to reverse direction when angle6 reaches 1000 and to stop when angle6 returns to 0.



```
to fan.feedback
  resetrotation 6
  talkto "motora
  setpower 2
  on
  waituntil [angle6 > 999]
  rd
  waituntil [angle6 < 1]
  off
  rd
end
```

- Type `fan.feedback` in the Command Center to run the procedure.



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